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ABSTRACT

This guide was written to help rural elementary schools implement science teaching strategies for motivating students and to identify outside resources for strengthening science instruction. The guidebook emphasizes the need for active administrative leadership and strong teacher involvement in planning and implementing partnership activities. The book is divided into nine chapters and provides both general information and specific examples relating to instructional approaches, recruiting and working with partners, and ways of assessing and supporting partnership programs. Chapter 1 discusses the need for science partnerships and encourages planning that puts partnership activities within a larger context of goals for general science-instruction improvement. Chapter 2 discusses elements of effective science instruction, teacher training, and the use of "hands-on" science education. The chapter also encourages educators to use local resources and to integrate science content into other curriculum areas. Examples of potential partnerships are offered. Chapter 3 is a guide for involving teachers in improvement efforts. Various steps of the planning process are detailed. Chapter 4 offers strategies for establishing science partnerships, including tips for identifying and contacting potential partners, clarifying partnership goals, and establishing good working relationships. Chapter 5 describes partnership concerns, including liability and safety issues, scientific ethics, and disabled students' needs. Chapter 6 describes ways of involving parents. Chapter 7 deals with program assessment and evaluation. Chapter 8 is a guide to fundraising. Chapter 9 offers more general suggestions for those embarking on partnership efforts. The document includes a bibliography of 54 references and a brief history and description of the New Mexico Rural Science Education Project. (TES)

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USING PARTNERSHIPS TO STRENGTHEN ELEMENTARY SCIENCE EDUCATION:

A Guide for Rural Administrators

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Developed through

Strengthening Science in Rural, Small Schools

a joint project of

Southwest Educational Development Laboratory
New Mexico Museum of Natural History
New Mexico Center for Rural Education

Wesley A. Hoover, Project Director

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USING PARTNERSHIPS TO STRENGTHEN ELEMENTARY SCIENCE EDUCATION: A GUIDE FOR RURAL ADMINISTRATORS

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PREFACE

Purpose, Audience, and Approach

This guide has two purposes:

- to help rural elementary schools implement science teaching strategies that can motivate kids and improve student achievement, and
- to help those schools tap outside resources that can strengthen science instruction.

It is written primarily for superintendents and principals, who must make the ultimate decisions about instructional approaches, resources, and relationships. However, it can also be used by teachers, curriculum supervisors, staff developers, and others interested in improving rural elementary science education. (Much of the information also can be applied in urban and suburban schools.) We have made certain assumptions about our audience: namely, that you and the school(s) you serve have limited resources, that you have more responsibilities than time to fulfill them, that you nevertheless constantly search for ways to improve, and that you are willing to take on a new effort *as long as you perceive a payoff for the students you serve*. We believe the program ideas contained in this guide offer such a benefit.

The material presented here offers a structure and guidelines through which the rural principal or superintendent can provide leadership in developing science partnership programs. It includes both general information and specific examples related to instructional approaches, strategies for recruiting and working with partners, and ways to assess and support partnership activities. The guidebook emphasizes the need for:

- active administrative leadership and support,
- strong teacher involvement in planning as well as implementing partnership activities, and
- a planning process that places specific partnership activities within the larger context of the school's goals for science improvement.

While this guide was inspired and made possible by a particular rural science partnership program, we have attempted to give it the broadest possible applicability. We have drawn our ideas and information, therefore, not merely from a single program, but from a range of experience and resources.

Origins and Background

This guide has been developed through "Strengthening Science in Rural, Small Schools," a national dissemination project involving the cooperative efforts of three agencies: the South-

west Educational Development Laboratory (SEDL) in Austin Texas; the New Mexico Museum of Natural History, located in Albuquerque; and the Center for Rural Education at New Mexico State University in Las Cruces. Funded by the U.S. Department of Education's Office of Educational Research and Improvement, "Strengthening Science" was designed to encourage the creation of hands-on science programs that link rural elementary schools with museums and other community resources. The major focus of "Strengthening Science" has been to showcase a set of outreach and education strategies developed through an earlier science partnership program, the New Mexico Rural Science Education Project (NMRSEP).

The original NMRSEP project, initiated in 1986 with a grant from the National Science Foundation, was a joint venture of the Museum of Natural History and the Center for Rural Education. NMRSEP capitalized on the natural settings of rural schools to make science exciting, relevant, and achievable for both teachers and students. NMRSEP was based on the assumption that rural schools, so often described as disadvantaged in terms of teaching resources, actually have a "leg up" in addressing the current national crisis in science education.

Rural schools have access to natural resources -- the woods, pond, field, mountains, coastline, or desert just beyond the schoolyard -- that most urban schools lack. Both teachers and students come to school with a great deal of informal knowledge about the area in which they live. But to tap these resources and apply their own knowledge, teachers need background information about the local environment. They need strategies for relating such information to the science curriculum, and for incorporating local resources into hands-on learning activities that stress science concepts and students' thinking skills. Perhaps most important, teachers need enthusiasm for science and confidence in their own knowledge and abilities.

NMRSEP was designed to meet those needs. Through inservice workshops, field trips, and other activities conducted by staff from the Museum of Natural History and the Center for Rural Education, elementary teachers in rural schools across New Mexico learned about wildlife, plants, rocks, and fossils and about other resource agencies that can support science instruction. Teachers also learned how to develop and use hands-on science activities that center on local natural history and that address district and state curriculum goals and student competencies. (Since the expiration of grant funding, NMRSEP has continued to operate, on a smaller scale, through the New Mexico Museum of Natural History. A full history and description of the program is included in Appendix A.)

NMRSEP was identified as a "promising practice" by one of SEDL's regional programs, the Rural Small Schools Initiative, in 1987. SEDL then selected the project as the foundation for a successful competitive proposal to the U.S. Office of Educational Research and Improvement that was submitted during the summer of 1989. As a result, "Strengthening Science" was funded for one year to:

- develop an implementation manual for museum staffs, outlining NMRSEP's approaches,

- develop a guidebook for rural educators, describing ways of working effectively with museums and other community resources on science partnership projects like NMRSEP, and

- conduct demonstration workshops and a national dissemination conference based on these materials.

Because this guidebook is intended to be as broadly applicable as possible, it does not focus exclusively on the methods and activities of the NMRSEP project. Rather, it uses NMRSEP, the current literature on science education and partnerships, and the broad experience of both SEDL and the Center for Rural Education as a base for suggesting effective science partnerships not only with museums but with a host of other agencies as well.

This guide was written by staff from the Center for Rural Education and SEDL. A companion document, *Strengthening Science Outreach Programs for Rural Elementary Schools: A Manual for Museum Staffs*, has been developed by the New Mexico Museum of Natural History and SEDL staff, and is available from either SEDL or the Museum.

ACKNOWLEDGEMENTS

A number of agencies and institutions contributed to the success of both NMRSEP and "Strengthening Science" as well as to the development of this guidebook. The National Science Foundation provided funding for NMRSEP's first two years of existence; a grant from the New Mexico Commission on Higher Education extended the project's development for a third year. Thirteen rural New Mexico school districts — Alamogordo, Bloomfield, Central Consolidated, Cobre, Cuba, Dulce, Eastern Navajo, Estancia, Hatch, Los Lunas, Magdalena, Ramah Navajo, and Zuni — participated in NMRSEP activities during those three years and provided invaluable feedback regarding the utility of the project's educational strategies. Cuba Elementary School, and Katherine P. Gallegos and Peralta Elementary Schools in Los Lunas, graciously served as demonstration sites for the "Strengthening Science" museum educator workshops.

Credit also should be extended to numerous individuals for their supportive efforts. Don B. Croft, Everett Edington, Jeffry Gottfried, and Thom Votaw originally conceived NMRSEP (in the Owl Bar, San Antonio, New Mexico) and laid the groundwork for its inception. Gottfried and Croft provided leadership as principal investigators for the initial grant; Edington, Gottfried, Votaw, Belinda Casto-Landolt, Judy Dacus, Nora Hutto, Michael Judd, Theresa Martinez, Lynn Rodgers, Michael Sanchez, and Rebecca Smith all worked as staff during the course of the project.

Preston Kronkosky, Wes Hoover, and Martha Boethel from SEDL; Jon Callender, Michael Judd, Rebecca Smith, and Michael Sanchez from the Museum of Natural History; and Nora Hutto from the Center for Rural Education were all involved in conceptualizing the "Strengthening Science" project. Hoover, Boethel, Judd, Smith, Sanchez, and Hutto, along with O.D. Hadfield, Betty Rose Rios, Thom Votaw, and Fred Lillibridge from the Center for Rural Education, were responsible for the project's development, demonstration, and dissemination activities. Lori Snider at SEDL provided invaluable support services, including assistance in the layout and production of this guidebook. SEDL staff member Rosalind Alexander-Kasparik designed the guidebook's cover; Martha Boethel edited the text.

Providing expert review for outlines and drafts of this guidebook and/or the manual for museum staffs were: Carter Collins, SEDL's institutional liaison with the U.S. Office of Educational Research and Improvement; Jeffry Gottfried, now at the Oregon Museum of Science and Industry; Teri Lipinski, formerly a rural education specialist with the National Rural Development Institute and now a school counseling psychologist with the Kalispell, Montana, School District; Gretchen M. Jennings, Senior Museum Education Officer with the American Psychological Association; and Lori Gates, Shirley Hord, Gayla Lawson, Pam Bell Morris, and Marianne Vaughan, all from SEDL.

Project efforts were greatly strengthened by the participation of ten teachers from rural New Mexico school districts. Debra Gurule and Pita McDonald from Cuba School District, and Marilyn Gentry and Bobbie Salaz from Los Lunas School District helped with initial plans for

the guidebook, manual, and project meetings; critiqued project materials; allowed observers into their classrooms; and helped conduct workshop and conference sessions. In addition, Joanne Montoya and Floyd Pena from Cuba, and Judy Carson, Kathleen Lerner, Angie Lucero, and Gloria Marcotte from Los Lunas allowed demonstration workshop participants to observe in their classrooms. The hospitality and cooperation of Joe Lopez and Hugh Prather, superintendents of those districts; Yolanda Denny, principal of Peralta Elementary School; Maribelle Ogilvie, principal of Katherine P. Gallegos Elementary School; and Edumenio Gurule, principal of Cuba Elementary School, are also deeply appreciated.

1. THE IMPORTANCE OF PARTNERSHIPS FOR RURAL SCIENCE EDUCATION

Why should a busy rural administrator, concerned about finding enough funds to avoid staffing cuts next year, or wondering how teachers will fit eight hours of state-mandated instruction into a five-hour instructional day, take the time to consider science partnerships? What can a partnership program offer other than more demands on your time, more people to please, and more schedules to juggle?

The answer is that partnerships can offer a great deal, including:

- enriched experiences for students through access to new resources and expertise,
- increased communication and support between the school and the community,
- access to new role models for both students and teachers, and
- increased outside funding of programs, projects, and ideas.

In these days of high expectations and shrinking public resources, more and more schools must seek outside assistance and strengthen their relationships with the community at large. Partnerships are especially needed to offer schools training, materials, resources, and ongoing support to strengthen science education, particularly in the elementary grades.

The Need for Science Partnerships

We are facing a crisis in science education, a crisis of motivation as well as of achievement. Fewer and fewer students are prepared for, or interested in, advanced science courses or careers. Students also are graduating without the kinds of thinking and problem-solving skills employers say they need in an increasingly technological workplace -- skills that effective science instruction can develop and enhance. As a result, American students have fallen far behind their Asian and European counterparts in science and mathematics achievement. Even more disturbing, a smaller and smaller portion of the American work force possesses the job skills and knowledge necessary to support this country's continued productivity and economic development.

The problem begins in elementary school. Most experts agree that students are "turned off" from science as early as the fourth and fifth grades, and that by the middle and high school grades it is too late to rekindle their interest. A recent cover story in *Newsweek* sums up the general consensus as to why American students lag so far behind others in science:

> Unfortunately, few American students ever get to taste real science, for few of the nation's schools teach it... American science education serves not to nurture children's natural curiosity but to extinguish it with catalogs of dreary facts and terms. (*Newsweek*, April 9, 1990, page 52)

This is not to say that schools and teachers are not working as hard as they can to teach science in effective and interesting ways. What is true is that many teachers -- especially elementary teachers and especially teachers in rural districts already struggling to make ends meet -- need help to gain skills, instructional resources, and confidence in teaching science.

Most university teacher preparation programs no longer focus on specific subject content, but rather on general education. This can place elementary teachers at a disadvantage, as they are expected to be knowledgeable in all content areas. Teachers in rural schools are sometimes professionally isolated, their opportunities for growth limited by time, distance, and economics. They may have to teach many subjects at several grade levels; they may have to work a second job to supplement modest salaries. Science instruction also tends to get crowded off the daily schedule by state mandates for language arts and other subjects; few teachers have the time, confidence, or skills to integrate science instruction with these mandated subjects. Teachers' problems may be compounded by the lack of funds in the school's budget for training, science equipment, and supplemental learning materials.

What Partner Agencies Can Offer

Partnerships can help address all these problems. Partner agencies and individuals can offer a variety of services and resources, including teacher training, resource information and materials, classroom demonstrations, access to collections and exhibits, access to facilities, and contributions of resources.

For the administrator, partnerships can also serve as vehicles to foster support from business and organizational constituencies. When community organizations and individuals are involved with schools, a sense of ownership is developed for both the process of education and the participants in the process. Community members who become involved in school partnerships increase their knowledge of the educational process and its needs. They gain first-hand experience on which to base decisions. Through a working relationship with administrators, teachers, and students, partners develop a real understanding of the problems, needs, and commitments of the educational system. Such understanding and support are critical in these days of public skepticism and reluctance to support tax levies or school bond issues.

The Guidebook's Approach to Partnerships

Partnership activities may vary from the modest to the substantial, from one-shot activities to long-term relationships. "Partners" can be almost anyone with whom you set up a cooperative relationship -- an agency, like the U.S. Forest Service or an area museum; a business, such as a

nearby food processing plant or the local car dealership; an organization like the Lions Club or Audubon Society; or even individuals. In fact, some informal science partnerships probably already exist in your school. Perhaps a retired geologist demonstrates her mineral collection to third graders every year, or a class visits a nearby lumber mill.

However, in this guidebook we encourage you to take a larger view of partnerships -- to think and act in terms of activities that support *a comprehensive plan for improving science instruction.* That is, we encourage you to work with teachers and, as you can, with partners, to:

- decide that effective science instruction is an important and achievable goal for your elementary school,
- determine the kinds of science teaching strategies that will be effective with your students,
- identify teachers' needs for assistance -- training, materials, activities, equipment, speakers, etc. -- in using those teaching strategies, and
- identify outside resources that can help make science interesting and relevant to students and teachers alike.

In some instances you will be able to locate partner agencies that can help you through this entire process -- for example, a center for rural education at an area university, or a special program such as the New Mexico Rural Science Education Project. Even if your school is so isolated that you cannot access long-term assistance, there is still much you can do. You can develop your own goals and plans, perhaps with some consultation from the state department of education or an educational service center or co-op. Then, using the strategies suggested in this guidebook, you can identify short-term partnership activities that fit into your long-term improvement plans. These activities still may include the retired geologist's mineral collection and the trip to the lumber mill. The difference, however, will be that these activities are no longer novelties, largely disconnected from the curriculum or goals for students' science skills. *Whatever the level of partnership activities you are able to achieve, the key to their success will be the extent to which they enhance and support your school's ongoing approach to science instruction.*

2. STRENGTHENING ELEMENTARY SCIENCE INSTRUCTION

Improving elementary science instruction is a complex undertaking; it often requires not merely a new set of textbooks or a few inservice sessions, but a significant shift in your staff's approach to instruction. On the other hand, teaching science the way it *should* be taught can be both exciting and rewarding. Teachers find that they do not need to be science "experts" in order to be good teachers. Many teachers are pleased to learn that their instinctive use of hands-on learning approaches is supported by research and experience, and that resources are available to help them expand their activities. Students find that learning can be interesting, engaging, even fun. Finally, you may discover that the benefits of effective science instruction can spill over into other curriculum areas as well, making your job easier and improving student outcomes.

The Elements of Effective Science Instruction

We recommend an approach to science education that incorporates the following instructional principles:

- Students -- and teachers -- learn more, and retain that learning longer, when they are actively engaged in the learning process.
- Students and teachers learn more effectively when the instructional process incorporates more than one learning style -- for example, tactile as well as visual and auditory learning.
- Students and teachers can be excited by science, and can learn more effectively, if science concepts, processes, and facts are rooted in their own environment and experience.
- Effective science instruction addresses three elements: *specific facts* (e.g., sandstone is a sedimentary rock), *science processes and concepts* (e.g., how sedimentation occurs), and *students' science process or thinking skills* (e.g., observing and classifying sedimentary, igneous, and metamorphic rock). Facts are of little use without a grasp of the underlying processes. Neither facts nor processes are of much value if such knowledge cannot be applied to solve problems or answer other questions.
- At the elementary school level, effective science instruction is primarily a process of *guided discovery*, in which students observe, explore, question, experience cause and effect, and test possible outcomes. Such instruction taps and builds on students' natural curiosity and the informal knowledge they possess about their environment.
- Effective elementary science instruction integrates science and other subject matter in ways that strengthen both subjects.
- Effective teachers facilitate learning rather than merely acting as repositories of knowledge.

The following sections describe ways in which you can draw on partnership activities to help integrate these principles and approaches into your school's science education program. In addition, a chart at the end of the chapter lists a number of examples of potential partners and activities.

Training Teachers in Effective Science Instruction

One of the most critical resources you will need is assistance with staff development. Staff development -- which includes teacher training, consultation, and follow-up support -- is the key to any instructional improvement. In this case, staff development can help teachers overcome any fears about teaching science, as well as help them identify and use instructional strategies that will work with their students. Partners can help you develop a comprehensive staff development plan; they can conduct inservice and other training activities; they can consult with teachers, observe in classrooms, and provide materials.

You may be accustomed to using outside agencies or consultants to conduct inservice training in your school or district. However, we have some suggestions that may be of help:

- Think of staff development as an ongoing process whose elements form an integrated whole. Plan inservice sessions that relate to and build on one another; supplement them with follow-up support, observations, and consultations.

- To the extent your circumstances allow, look for staff development providers who are genuinely interested in a partnership endeavor rather than merely a contract for one or two in-service sessions. That is, look for agencies and individuals whose purposes match those of your improvement effort, who are interested in working with you every step of the way, and whose approach is collaborative and responsive rather than prescriptive.

- Cast your net more broadly than usual; you may be surprised to find an ideal partner in agencies that are not part of the formal educational system.

Using Hands-On Approaches to Teach Science Content and Thinking Skills

Rural partners can facilitate hands-on, process-oriented science instruction in a number of ways. Partners can train teachers in ways of presenting hands-on activities and can help develop or adapt such activities. They also can provide materials to the school, give demonstrations in the classroom, sponsor or lead field trips, help build and maintain nature trails, or sponsor or assist with science fairs.

Partners can offer a variety of materials, handouts, booklets, and tapes that expand the teacher's resources. Agencies such as the Forest Service, agricultural extension offices, and public utilities often prepare teacher or student learning packages that they are eager to share.

Partners may go beyond supplying materials and include their staff in the capacity of resource persons who serve as consultants for the teacher.

Classroom activities. Perhaps the most exciting contribution partners can make in the classroom is to give demonstrations or share specimen collections. These can be valuable learning experiences if they are linked to participatory learning activities that encourage students to explore, observe, and hypothesize. Demonstrations in which partners conduct hands-on learning activities with students are also valuable for teachers, giving them the opportunity to observe as the partner models hands-on instructional strategies.

School or classroom specimen collections. Classroom or school collections represent valuable learning resources. Using locally collected specimens, for example, students can classify rocks, wildlife, and plants; observe different characteristics in similar species; analyze changes in plant or animal appearance and behavior; and hypothesize about different growth patterns in identical plant specimens.

School or classroom specimen collections might include minerals, rocks, plants (living and pressed), insect or spider collections, bones, and the like. Partners can help to develop such collections for use as teaching tools. Museums, colleges, secondary schools, and individuals often have collections or single specimens that they will contribute or lend to schools.

However, it is essential to remind teachers, students, and partners that collecting requires adherence to both laws and ethical codes, and that respect must be paid to private property and to the environment. There are laws governing the collection of certain birds, fish, mammals, fossils, and archaeological specimens, and the school needs to investigate applicable laws and regulations. (Partner agencies can also help with this task.) Cultural traditions and norms also need to be observed (see Chapter 5), as do principles of ecology, respect for wildlife, and concern for the preservation of scientific knowledge. In some instances, there also may be health and safety issues to be addressed.

Field trips. Another useful contribution that partners can make is to underwrite the cost of field trips and/or to lead tours of their facilities. Field trips can stimulate or reinforce classroom learning, making abstract concepts concrete and applicable to students' daily lives.

Field schools. Field schools are structured outdoor activities in which several teachers pool their resources and conduct a series of simultaneous outdoor learning activities for students. Field schools are somewhat similar to athletic field days, except they focus on science, and all children participate. Small groups of children stop at each of a series of learning stations for 30 minutes or so, explore a science concept, and then move on to another station. For example, students at one station may take water samples from a nearby pond and study them under a microscope, while those at another station may classify rock samples. Each station has a "teacher" (not necessarily a school teacher) and the requisite equipment.

Partners can be of great help with field schools. Business partners can sponsor the entire event, underwrite transportation if the field school is held off the school grounds, or supply volunteer

teachers or equipment. Retired persons or museum volunteers can staff the stations, as can members of local nature societies or clubs.

Field schools require a real commitment of time and effort. Tasks include identifying an appropriate site, planning activities, and lining up volunteers, equipment, and materials; in addition, the school day must be rescheduled and numbers of students must be transported to the field school site. However, the effort can result in a much greater commitment to and enthusiasm for science on the part of teachers, students, and the community.

Science fairs. Partners can be useful in planning and running science fairs. Science fairs may follow established guidelines or those developed by teachers, administrators, and partners. Some schools may prefer projects that show models and displays rather than the research projects that follow the more traditional scientific method guidelines; the magazine *Science and Children* publishes many articles concerned with alternatives to the usual science fair. If you prefer the more traditional approach, you can contact the state department of education for guidelines.

Nature trails. A nature trail leads students through and by naturally occurring plants, animal habitats, waterways, and/or geological formations. Along the way there are planned stops where learning activities can be conducted.

Almost any rural school district can build its own nature trail; rural schools often have space available to construct nature trails. State and federal forest service agencies, soil conservation agencies, and county agents all have information regarding the construction of nature trails. Partner agencies can donate plants, materials, and/or labor. Museum or other educational partners can help identify learning stations, develop learning activities, or prepare trail guides or resource manuals. Partners may volunteer to construct the entire project and/or help to maintain it. A carefully planned and well maintained nature trail can be a source of interest and pride for the entire community, as well as being used by students at all educational levels.

Taking Advantage of Local Natural Resources

Rural schools have some advantages over their urban counterparts in making science relevant to students' lives and experience. Every locale has its own unique and readily available natural history materials. Teachers do not need to be limited by textbooks when there is a veritable storehouse of materials right in their own backyards.

Through the New Mexico Rural Science Education Project, for example, teachers identified local sites that offer opportunities for experiential learning. Project staff pointed out possibilities that teachers had seen and lived with but never perceived as learning resources: a road cut that exposed overturned rock layers and a seam of bituminous coal; a pond across from the school that could be used to take samples of aquatic life and to study water quality; a copper mine "just up the road" whose owner welcomed students and teachers alike. Even in a district whose surroundings seemed empty and unpromising, project staff helped teachers develop lively, useful lessons.

The weed field next to the school became a learning laboratory. Its materials were tumbleweeds, insects, and dirt; its subjects were erosion, symbiosis, and the physics of building anthills.

Project staff also loaned teachers specimens of fossils that could be found in their local area, skull collections for use in observing and classifying animals according to what they eat, and other learning resources. They helped teachers to set up their own science corners and specimen collections and to design nature trails complete with student learning stations. All of these activities drew on the local environment, and supplemented the regular science curriculum.

You may be fortunate enough to find a single partner agency that can provide all of these services. If not, however, you can put together your own "package" of partners to achieve similar results. Agricultural extension agents, U.S. Forest Service or state and national park service staffs, and other experts can help identify and provide background information on local science resources. Parents and community members also have a great deal of information to be tapped, from identifying medicinal herbs to pointing out the locations of interesting landforms or wildlife habitats. Building collections of local specimens or developing a nature trail can become a community project.

Integrating Science Content into Other Curriculum Areas

The excitement of hands-on science can be captured and channeled across other instructional areas, increasing student interest and achievement in reading, mathematics, and other subjects as well. By integrating science and other subjects, teachers can reinforce the concept that all subjects, when applied in the real world, are interrelated. Integrating instruction also increases the time available to teach science -- a critical concern in the early elementary grades, where mandates for other subjects often crowd science off the daily instructional schedule.

Partners can help here, too, through teacher training, demonstrations and presentations, and provision of materials and resources.

Reading and language arts. Language arts is a natural complement to hands-on approaches in science. Students can prepare oral or written reports about what they have studied, read about famous scientists through their biographies or autobiographies, write their own hypotheses or record their observations, and write stories or descriptions related to field trip or field school experiences. Many science-related books are available through school or local libraries. Each issue of the magazine *Science and Children* has reviews of suggested books for elementary librarians and teachers to purchase. In addition, a useful resource book for teachers, *Science Through Children's Literature: An Integrated Approach*, by Carol M. Butzow and John W. Butzow (Teacher Ideas Press, Libraries Unlimited, Inc., P.O. Box 3988, Englewood, Colorado, 80155-3988) contains participatory science activity ideas drawn from children's literature. If funds are not available to purchase books or materials, this is an opportunity for a partner to make a valuable donation.

Mathematics. Mathematics is an excellent discipline to integrate with science, since it is an essential tool for scientific study. Children can measure and calculate heights of plants, weights of ani-

mals, thicknesses of rock layers, distances that objects travel, and the time required for reactions. They can chart changes in soil, water, and air temperature, and count the legs on insects or petioles on leaves. Again, partners can help with teacher training, demonstrations, and materials. They may demonstrate some of the mathematical approaches that are used in their particular business or industry. They may even be willing to loan or donate necessary equipment or materials.

Social studies. Social studies can include a focus on the ways in which science influences social, economic, political, and cultural practices. What natural resources are available in different areas? What specific crops or wildlife make the area interesting and important? Are there pollution, agricultural, or energy problems? Is technology an important part of the civilization? Are there health concerns that affect traditions, lifestyles, or the economy? How do people in different parts of the world develop solutions to similar problems? Partners can assist by providing information, artifacts, or materials from other areas of the world. Partners with different cultural backgrounds can discuss scientific traditions and contributions within their cultures.

Examples of Potential Partnerships

Activity	Examples of Potential Partners
Training to improve teachers' science skills and interest	Regional education service centers Rural education centers College and university schools of education Regional educational laboratories State departments of education National laboratories Museums of science, natural history, technology, anthropology Zoos, aquaria, science centers, observatories Children's museums National park staffs U.S. Forest Service staffs Project Wild and Project Learning Tree trainers
Provision of educational materials and/or background information on science topics	See list above Rural electric cooperatives Conservation and nature societies County extension agents State departments of energy and wildlife Bureau of Land Management
Provision of specimens or equipment for classroom use	Greenhouse operators Plant societies Botanical gardens Farmers, ranchers, gardeners Landscape architects Geologists, naturalists Gem and mineral clubs Mining engineers Conservation and nature societies Universities County extension agents Lumber mills Manufacturers Feed stores Pet shops Wilderness outfitters

Activity	Examples of Potential Partners
Teacher information sessions, classroom presentations, or field school stations	See list above Curanderas, folk healers Hobbyists U.S. Forest Service staff Bureau of Land Management staff Park service staff State departments of energy and wildlife Rural electric cooperatives Utility workers
Provision of access to field trip sites	Farmers, ranchers, other landowners Tribal councils Bureau of Land Management U.S. Forest Service Park services Utility companies Miners Lumber and paper mills Food processing companies Museums, science centers, zoos, aquaria, botanical gardens Weather and energy research facilities Observatories, radio astronomy laboratories
Assistance in developing a nature trail	Science and natural history museums Botanical gardens County extension agents Landscape architects Nature societies Naturalists, geologists, bird watchers U.S. Forest Service Lumber yards Building contractors Lions, Rotary, Optimist clubs Parent-teacher organizations Vocational education classes Parent and community volunteers

Activity	Examples of Potential Partners
Research on conservation and collecting ethics and laws	Museums and science centers Park service staffs Bureau of Land Management U.S. Forest Service Tribal councils Bureau of Indian Affairs Naturalist and conservation societies Geologists, anthropologists, archaeologists, naturalists Reference librarians Volunteer researchers
Funding support	Local businesses Lions, Rotary, Optimist clubs Chamber of Commerce Beta Sigma Phi or other women's sororities Garden Club, Botanical Society Audubon Society, Sierra Club Parent-teacher organizations Rural electric cooperatives Manufacturers Corporations with local or area offices Local and area foundations County, State, and Federal agencies
Fundraising assistance and information	Community organizations (see list above) Local corporate representatives Rural education centers Regional education service centers Colleges and universities State education agency staffs Regional educational laboratories Volunteer planners, accountants, writers
Assistance with program planning and needs sensing	See list above Museums
Assistance with evaluation activities	Rural education centers Regional education service centers Colleges and universities Regional educational laboratories State departments of education Volunteer retired teachers, planners, statisticians

3. INVOLVING TEACHERS IN YOUR IMPROVEMENT EFFORTS

Administrative leadership is essential to the success of any school improvement effort. Teacher support is also critical for successful science partnerships. Teachers will determine whether partnership activities make a difference in the day-to-day conduct of science instruction. Both experience and the research literature on school change stress that you can take positive steps to assure teacher support for new efforts.

Involving teachers in planning as well as implementing a new program gives to those most affected by that program a sense of ownership in its success or failure. Such ownership and responsibility motivate the participants to work for the success of "their" plan.

Establishing a Planning Committee

The first step in developing a formal science partnership program is for school staff to agree that a partnership program is a worthy endeavor, and to develop plans and priorities for making it happen. You may want to appoint an in-school Science Improvement Team responsible for planning and overseeing program activities. Including strong teacher representation on the team will help generate teacher support and will help assure that the planned activities fit teachers' needs and constraints. The Team also will need to seek input from the rest of the school staff and keep all teachers informed about planned activities.

When forming a planning committee or Science Improvement Team, it is helpful to include a mix of teachers, administrators, and, if possible, school board members. The ideal committee member will be committed to school improvement, willing to work hard, and respected by the school staff. The individuals you select, and the selection procedures you use, will of course depend on your specific circumstances. You may prefer to appoint committee members, to ask for volunteers, or to ask teachers to elect their own representatives. Each approach has advantages and disadvantages, and only you can determine which method will result in the best mix of committee members' skills, attitudes, and credibility with their peers.

The same may be said for selecting a chairperson for the committee or Science Improvement Team. You may want to appoint that person, or to suggest that the group choose its own leader. Each approach can be equally effective, as long as teachers as well as the administration have confidence and trust in the leader. (Also keep in mind that the chairperson is a likely candidate for serving as an ongoing contact person with partner agencies, and will need both the time and the "people skills" to carry out that responsibility.)

Assessing Needs

Before you can decide what kinds of partnerships you are seeking, you must know what your school's science improvement needs are and what resources -- in terms of staff time and knowl-

edge, equipment and facilities, and fiscal resources -- you have available. Perhaps your needs are apparent to everyone, and that is why you are reading this guidebook. However, in most cases it is helpful to do at least an informal needs survey. Needs assessments can alert you to problems and needs you had not considered and help you avoid difficult surprises later on. They are also another way to get your entire teaching staff involved early in the planning process. (Beware, however, of surveying teachers' needs and then ignoring the results! The quickest way to alienate staff is to ask for input and then disregard it.)

While a variety of needs assessment questionnaires are available commercially, you or your Science Improvement Team may want to design your own or adapt an existing instrument to fit your school. Again, if the instrument is developed or adapted "in-house," there is a sense of ownership. Such an instrument also will be more specific than a commercial instrument. On the other hand, using existing instruments can save time and effort. Two examples are included on the following pages; the first is a short, informal questionnaire that can be expanded easily to address local circumstances; the other is a survey form developed by the New Mexico Rural Science Education Project.

It is helpful to share the results of any needs-sensing activities with the entire school staff. Such sharing demonstrates your commitment to involving everyone and keeping communication channels open; it also helps the staff understand the basis for later plans and decisions.

Addressing Teacher Concerns and Constraints

Two factors could be described as primary among teacher concerns: time and self-image. Teachers are busy. Many feel over-worked, underpaid, and unappreciated. Many teachers are frustrated in their attempts to meet the wide-ranging student needs among the diverse populations they serve. Some attend school in the summer or outside training sessions at their own expense, for which they may receive little or no compensation. When student performance is low, lower teacher morale usually follows.

Given these circumstances, it becomes important to be sensitive to teachers' time constraints and to their possible concerns about new performance expectations. Implementing a new approach to science instruction, and bringing in outsiders to help with that effort, may require educating teachers to the benefits of these activities. In the long run, partnerships should reduce teacher preparation time. Working together should become easier and resources should be more readily available. Also in the long run, increases in student performance levels will improve teacher self-concept and morale. However, in the short term, partner activities may require more work as well as a venture into a subject area with which few teachers feel comfortable or competent.

It is also helpful to remember that, through their careers, teachers likely have been asked -- or, more often, ordered by the state or district or the building principal -- to try this new curriculum and that new teaching approach; they have watched as one instructional fad or mandate after another has come and gone. Teachers may be suspicious of yet another new program promising "improved" student learning.

What you can do to help alleviate such resistance is, first, to get teachers involved in planning, and second, to understand that it may take time for many teachers to begin to believe in the worthiness of the partnership effort.

Giving Teachers the Support and Flexibility They Need

Teachers embarking on a new endeavor will need conscious administrative support, including positive reinforcement for their successes and encouragement to overcome their failures. They will need the room to experiment, to fail, and to try again. Just as a supportive environment is important to a student, so too is it to teachers, especially when they are taking a risk by trying something new and different. It is important to verbalize your support. Talking about change and the feelings that people have when involved in the process can be useful, as can making yourself available to listen to concerns, complaints, and suggestions.

Your support also will need to be more than just verbal. As you are able, work to offer tangible support as well -- such as providing teacher stipends when training is scheduled on weekends, or extra funds (however small the amount) to allow teachers to purchase materials or equipment. If even small amounts of funding support are impossible, perhaps you can arrange for teachers to receive extra planning or meeting time. Or perhaps you can make accommodations in paperwork or other requirements. Contributing your own time to participate in meetings, to observe in classrooms, to "pitch in" with special events or classroom activities, also helps teachers feel your support for the program. The important thing is to demonstrate, in both action and words, that this effort is important to you and that you intend to support teachers in whatever ways possible.

One problem teachers often face in trying to use hands-on science approaches is the lack of flexibility in the school's standard curriculum. Here again, you can play a leadership role, encouraging teachers to move beyond the textbook to teach science objectives and competencies. You also can help teachers find ways to add more science teaching time to their daily schedules, by allowing more flexibility in that schedule, and/or by encouraging teachers to integrate science content into other basic instructional areas such as mathematics and language arts.

Finally, it is important to remember that, as one New Mexico teacher put it, "Science smells." When learning is occurring through creative activity there may be noise and excitement. Often students may not be at their desks but working in pairs or small groups. There may even be classes working together or classes meeting outside in a nearby field or next to a pond or creek. Science activities may generate strange sights and smells. The science corner may be messy, but that is a sign that students are actively engaged in science.

Sample Needs Assessment Questionnaire

1. If you had assistance teaching a science lesson, which lesson would you choose?

2. In which area of the science curriculum do you feel most knowledgeable?

3. In which area of the science curriculum do you feel least knowledgeable?

4. What assistance or resources do you need to improve science instruction in your classroom?

5. If you could make one change in your science program, what would that change be?

6. Can you think of any outside individual, agency, or business that could strengthen your science program by offering training, field trips, materials, demonstrations, or other assistance?

7. Do you have any other suggestions for improving our science curriculum?

Thank you for your time and help in improving our program.

New Mexico Rural Science Education Project
Science Teaching Resource Inventory

1. What grade level(s) do you teach?

2. How much time each day or each week does your class spend on science?

3. What science education textbook series do you use?

4. What other science education materials do you use?

5. What major science concepts and content areas are covered in the grade you teach?

6. To what types of equipment do you have access for teaching science in your classroom?

7. To what types of specimens do you have access for teaching about natural history?
   a. Rocks and minerals:
   b. Fossils:
   c. Plant materials:
   d. Bones, feathers, live animals, etc.:

8. To what kinds of reference or background resources (such as field guides) do you have access?

9. How many field trips or other outdoor science activities do you conduct during the school year?

10. Where do you usually go on field trips?

11. What kinds of hands-on activities do you use in teaching science?

12. What problems have you encountered in teaching science?

13. Would you like assistance with:

____ strategies and activities for teaching hands-on science?

____ ways to relate your science curriculum to the local environment?

____ ways to integrate science into other subject areas, so that you can increase the time your class spends studying science?

____ developing specimen collections for teaching science? (If yes, which types of collections?)

____ how to use scientific equipment? (If yes, which types of equipment?)

14. What other assistance could help you to strengthen your science instruction?

4. STRATEGIES FOR ESTABLISHING SCIENCE PARTNERSHIPS

Planning for Partnership Activities

As noted earlier, partnerships can take many forms, from one teacher inviting a local geologist to present her mineral collection to an effort like the New Mexico Rural Science Education Project, which involved formal agreements with the school district and activities spanning a year or more. If you are serious about using science partnerships to strengthen student achievement, you are looking at more than the initiative of a few individual teachers. What is needed is a coordinated effort that builds teachers' skills and enthusiasm, the school's resources, and student learning in a developmental sequence.

Deciding what kinds of partnerships you need. Once your needs survey is completed (see Chapter 3), you or your Science Improvement Team can look for indications of strengths and weaknesses in your current program. The survey results can be analyzed to identify partners that may support and strengthen teachers in specific areas. Is your biggest need for staff development? resource materials? equipment? field trip opportunities? If staff development is the need, do teachers need science content training? Do they need help in using hands-on, process-oriented instruction? Or do they need help with specific instructional strategies? If teachers say they don't have enough time to devote to science, they may need staff development in ways of integrating science with other instructional content.

If your school is like most elementary schools, you will find needs in almost every area. Sometimes the task of planning for science improvement can seem overwhelming. It can be helpful, then, to set both long-term and short-term goals, with the short-term goals modest enough to be achievable and yet ambitious enough to present a challenge. (Some examples of short- and long-term goals are presented on the following pages.) The team also will need to set priorities for partnership activities, deciding how much energy to expend on long-term versus short-term activities, resource support versus teacher training, etc. It is in this planning process that the character and make-up of your Science Improvement Team become critical, because the Team will need a thorough understanding of what teachers can handle and support.

How to Identify Potential Partners

Desirable partner characteristics. Another task for the Science Improvement Team is to establish some basic criteria that can be applied to potential partners. Although local conditions and needs will determine local criteria, we suggest the following general characteristics:

- **Relationship to science.** Potential partners need expertise in applying scientific knowledge and principles in their daily operations. However, this knowledge need not be formal; many "regular folks" have a great deal of informal expertise that can be tapped.

Examples of Long-Term Goals for Science Partnerships

Five-year goals:

1. Science will be taught in every classroom in every grade, every day.
2. All teachers will demonstrate an understanding of effective science teaching principles, and will apply those principles in their classrooms.
3. The school will develop and implement, school-wide, its own hands-on science curriculum, using the local environment as an instructional laboratory.
4. Every classroom will have ready access to microscopes, hand lenses, compasses, and any other equipment needed for teaching science.
5. Field trips, classroom demonstrations, science corners with specimen collections, and outdoor classes will be a regular part of every class's science activities and resources.
6. The school will have a well-maintained nature trail, complete with learning stations, a trail guide, and supporting resource materials, that every class uses on a regular basis.
7. The school will sponsor an annual elementary science fair in which 90 percent of students will participate.
8. Students' grades in science and mathematics will improve by 25 percent.

Examples of Short-Term Goals for Science Partnerships

One-year goals:

1. All teachers and aides will receive inservice training and follow-up consultations in ways of using hands-on learning activities to teach science concepts and thinking skills.

2. All teachers and aides will receive inservice training and resource information about ways of using the local environment as a learning resource.

3. The school principal and a member of the Science Improvement Team will consult with each teacher to determine their needs for follow-up assistance related to the training they receive; the Science Improvement Team will arrange for follow-up as needed.

4. The Science Improvement Team will develop and provide all teachers with a list of potential partner agencies that can offer field trips, conduct classroom demonstrations, lead and model instructional activities, or furnish resources; the list will match potential activities with state-mandated process skills.

5. All teachers will conduct at least four outdoor science activities with their classes during the school year, and at least four activities using a resource partner.

6. The Science Improvement Team, with help from the fifth and sixth grade classes, will identify and work with a local community organization or business to raise funds for purchasing four microscopes for each of those grades.

7. Every class will set up a science corner and begin collecting specimens (plants, rocks, minerals, bones, seeds, snakeskins, birds' nests, etc.) for the science corner.

- **Educational component.** It is helpful if a partner agency has an educational component and is mandated or funded specifically to provide services or materials to schools. The optimal partnership situation occurs when the school's needs match the partner's required functions. In addition, partners need at least a general grasp of instructional strategies for elementary-age children, and of the way schools function.

- **Proximity.** Potential partners need to be located near enough to the school that partnership activities can actually be accomplished. However, this does not limit you only to your immediate community. Some agencies encompass a broad, even statewide, service area.

- **Reliability**. It is important that activities with a potential partner can be scheduled with some certainty. There is little to be gained when canceled activities cause disgruntlement all around.

- **Low cost or free services.** It is a given that the partner's services must be free or provided at low cost.

- **Adaptability.** Potential partners must be able to address the needs of teachers and students in an elementary setting. This means they can adapt scientific vocabulary and discussions to their audience, and adjust activities to match their attention, experience, and levels of development.

- **Ecological perspective.** In these days of almost universal concern for conservation of our planet's natural resources and environments, it is important that any science education program include a focus on ecological concerns. We suggest that you inquire of potential partners as to their activities and concerns related to resource conservation. (See Chapter 5.)

- **Sensitivity to equity issues and cultural diversity**. Potential partners also need to demonstrate respect for diverse cultural values and beliefs, and to be alert to the need for taking positive steps to overcome racial, ethnic, and gender stereotypes. (See Chapter 5.)

- **Health and safety**. Student safety is a district's responsibility, whether in the classroom or on school-approved trips. If demonstrations are performed, the health and safety of teachers and the partners themselves also must be assured. Since the partners are the "experts," they should be knowledgeable about potential hazards and able to provide safety equipment when appropriate. (See Chapter 5.)

How to locate potential partners. Potential partners are everywhere. Most local businesses or industries use scientific principles that can be communicated to students. Even the smallest community may have access to the Forest Service, Bureau of Land Management, Farm Bureau, Agricultural Extension Service, Production Credit Association, electric cooperatives, telephone companies, the local pharmacist, or others. In addition, factories, companies, universities, educational service centers, museums, the Public Health Department, and a variety of others often have an outreach mandate. Many times all that is necessary to begin a mutually beneficial relationship is a phone call, letter, or personal contact.

Do not hesitate to approach potential partners located outside your immediate community. Many agencies or businesses have large service areas and are required to serve communities in which they operate but may not have representatives or offices.

To help identify partner resources -- and to let the community know about your effort -- you may want to inventory potential partners in the area. One option is to establish a school-community Partners for Science Improvement Committee (composed of the school's Science Improvement Team members and community representatives) that can help conduct an inventory. There are several ways -- or combinations of ways -- in which an inventory can be accomplished:

- A beginning inventory can be developed from information supplied by the Partners for Science Improvement Committee.

- A community information questionnaire can be developed and distributed by the Committee.

- Younger students and their parents can conduct "windshield surveys" of potential partners while driving in the community. A windshield survey is a simple technique in which you drive through an area, noting all items of interest, such as all of the businesses within a community. The survey, then, serves as a sort of "census" of possibilities that can be evaluated later. You can use a checklist to record information, or simply make lists. This might be a useful experience for developing community awareness.

- Older students can use the yellow pages, Chamber of Commerce materials, and other community listings to identify potential partners in area communities. This could be a useful language arts activity in learning to use resource and reference materials, and in producing a useable written product.

Compiling the inventory results can reveal more potential rural partners than you may think possible. Several categories of potential partners likely will be represented in the results:

- **Local agencies, businesses, unions.** Depending on the rural community, there may be agribusiness endeavors, extractive industries, factories, etc., all of whom use scientific applications in their processes.

- **Retired persons.** Many retirees have a tremendous wealth of information and knowledge that are in danger of being lost forever. Not only may these citizens have information of a scientific nature, but they also may be able to recount events about changes in the community and society as a whole that have resulted from scientific developments. Many may have tools, materials, or specimens that can be loaned or contributed to the school. The contribution of retirees to the school curriculum can be tremendous and graciously given. Moreover, a positive relationship between the school and retired citizens can have a greater possible impact on long-term school district financing than that of any other partners. Senior citizens often are resistant to bond issues because they are on fixed incomes or no longer have children or other relatives in school. Successful partnership experiences can decrease that resistance.

- **State and federal agencies.** Many state and federal agencies provide assistance to public schools as part of their institutional mission. Many times agency staff will conduct presentations or demonstrations. Some agencies may offer tours or field trips. While most agencies are not thought of as directly educational in their function, in reality they may have many educational applications to offer students.

- **Museums, zoos, botanical gardens.** These institutions can open another dimension to rural schools. Not only are there many types of museums (local community heritage, regional and state, natural history, industrial, technology, etc.), but the services they offer may vary as well. Many communities have small museums that can be used for field trips or whose staff will travel to schools to make presentations and allow hands on discovery by the students. Larger museums are likely to offer educational outreach services as well as guided tours for different age groups. Many museums develop portable exhibits, teaching kits, or Discovery Boxes for loan to schools; some offer teacher training activities. Occasionally, a museum or archaeology group will allow students to observe when a site is being excavated. Zoos and botanical gardens are less likely to have traveling exhibits, but they offer exciting and rewarding possibilities for field trips, consultations with teachers, and classroom discussions.

- **Colleges and universities.** Colleges and universities are a likely source for planning and staff development assistance. They also usually have state of the art equipment and displays. Universities often have biological specimens that can be shown to students. College and university students may visit the elementary school classroom as part of their required training, or professors may offer services to nearby schools in exchange for research data that would not otherwise be available.

- **Philanthropic agencies, clubs, organizations.** Philanthropic agencies often have grants or monies available for projects that might not otherwise be feasible for a school district. Often these agencies will only expend funds for specific categories of activity, such as the arts, science, math, rehabilitation, or other purposes. Community organizations such as the PTA, Lions Club, Rotary Club, Optimist Club, and others are good organizations to contact for "wish projects" or materials that can be used to enhance the education process. Sometimes these local organizations will contribute resources to the school for equipment that the local school budget cannot afford.

How to Contact Potential Partners

The community members of the Partners for Science Improvement Committee will be useful in providing guidance in how potential partners would like to be approached. In some cases, it might be beneficial to hold a general community meeting to explain the purposes of the proposed partnership program.

To initiate or continue informal partnerships, a telephone call by the chair of the school's Science Improvement Team or another team member delegated to do so probably will be sufficient. To initiate more formal partnerships, we suggest that an exploratory telephone call by a member of

the Science Improvement Team be followed by a visit and/or letter, from both the team member and the principal or superintendent, that carefully outlines the school's goals and expectations for the partnership.

How to Establish Effective Working Relationships

Identifying a school contact. Partnership activities often require a great deal of coordination. Someone needs to negotiate services, work out the schedule and logistics for partnership activities, and make sure there are enough support personnel to assist teachers during activities with students. If more than one class is to participate, even more preparation is required. Designating a school contact person -- the chairperson or a member of the School Improvement Team, or a lead teacher, instructional supervisor, or administrator -- to work with the partner can help streamline efforts and avoid confusion and miscommunication. It is important that the designated contact person be knowledgeable both about school policy and procedures and about teachers' schedules, activities, and concerns. The principal or superintendent, of course, ultimately must negotiate and approve any formal arrangements with partners; however, the contact person can lay the groundwork and serve as an information channel between partner and administrator.

Identifying a partner contact. It is also helpful to have a lead person for the partner (assuming that the partner is an agency or group rather than an individual) in order to make contact as expeditious as possible. To be most effective, the lead person should be the person who will be most intensively involved in the science activity. You, of course, cannot control the partner agency's actions, but you can often make suggestions or recommendations.

Setting up a cooperative agreement. For formal partnership arrangements that involve a sequence of activities, or even for a single, large-scale event, it can be helpful to lay out a written cooperative agreement between the school and the partner agency or individual. Especially if funds or other material resources are involved, a cooperative agreement can do much to avoid misunderstanding and clarify both parties' expectations. The agreement should be explicit about everyone's role and the expectations of both parties with regard to the content of the partnership activity.

The cooperative agreement may take the form of a letter or even a formal contract. (If a formal contract is needed, it probably will follow your district's format for a letter of agreement to provide services to the district.) Whatever the format, we recommend that the agreement include the following information:

- a specific description of the services the partner will provide and the audiences to be served,
- a general schedule for those services,
- any materials, equipment, or other resources the partner will provide,
- any payment, facilities, equipment, materials, staff support, or other resources or special arrangements the partner is expecting from the school,

- the name of your school's designated contact person, through whom the partner will communicate with school personnel and handle all arrangements, and

- the name of the partner contact person, to whom the school can turn for information and assistance.

Two samples of informal cooperative agreements are included on the following pages.

Assuring ongoing communication. One key to effective partnerships is frequent communication. The more you can keep in contact with your partner, and vice versa, the better things are likely to work. A phone call to check progress on arrangements, a letter summarizing the plans you made at your last meeting, follow-up phone calls after a training session or other activities -- these do a lot to avoid problems and build trust.

You will also want to formally thank the partner at the conclusion of the partnership activity, providing informal and, if possible, formal evaluative feedback about the effectiveness of the partnership activities.

Another important element of communication is to ensure that there is timely and adequate community publicity for partner activities. The experience needs to be worthwhile for the partner as well as for the school, and enhanced public image is a major reason many partners become involved in school science activities.

Sample Informal Partnership Agreement with an Individual

Dear Mr. Jones:

We hope you will have time to bring samples of your crystal collection to this year's sixth grade science class. Your visits and discussions over the years have awakened many students to the beauty, age, and commercial uses of minerals, especially our local minerals.

As always, I would like for you to demonstrate and discuss different uses of crystals in both traditional and modern cultures. In addition, we are studying various classification systems used to describe the natural world. It would be helpful if your samples could include representatives of the six systems of crystal forms and if you could share with us how crystal classifications are derived. The day before you come I will present the systems' names to the class so that much of the usual hilarity over pronunciation will have expended itself before you arrive.

We would like for you to come next Wednesday morning, if that is possible. Please call me Monday between 3:30 and 4:40 at 292-3738 so that we can finalize arrangements. (Or call the office and leave word as to what time during the evening I might call you.) If you are unable to come at this time, there is another time next month when your collection would be appropriate for our science unit.

Call me Monday, and many thanks!

Sincerely yours,

Sample Informal Partnership Agreement with an Agency

Dear Ms. Kobalowski:

I am writing to tell you how pleased we are that the Museum of Science and Technology will be working with us to improve our science program. I also want to take this opportunity to confirm my understanding as to what the museum will provide to our school through this partnership, and what support and assistance you are expecting from my staff. As I understand from our meeting of April 16, staff from your Education Division will provide the following services:

- A day-long teacher training session, to be scheduled during one of the school's designated preservice days in late August, which will introduce teachers to local natural resources and their uses as tools for science instruction.

- A follow-up training session, to be scheduled for either October 27 or January 10, depending on your calendar, that focuses on ways of integrating science instruction with mathematics and language arts, again using the local environment as a teaching resource.

- A resource manual of approximately 100 pages, presenting background information about the local environment, sources for additional resource materials, and learning activities that relate to our local science curriculum.

- Two consultation visits, to be held within six weeks after each training session, in which two of your staff members observe in classrooms and meet with teachers to discuss progress and problems.

For these services, the school will pay the museum a fee of $1,000 (which has been generously donated by the area rural electric cooperative). In addition, we will allow you to videotape the training sessions for your use in developing a training package for other museums.

The chair of our school's Science for Tomorrow planning committee, Ms. Gloria Flores, has agreed to serve as the school's principal liaison with the museum. You can contact her for any information you need and to make specific arrangements for your visits. She will join us at our next planning meeting on May 9.

Please let me know if any of the above information is not correct. Again, I am most pleased to be working with you; I look forward to seeing you May 9.

Sincerely,

5. CONCERNS TO ADDRESS IN CONDUCTING PARTNERSHIP ACTIVITIES

There are a number of considerations to address as you undertake partnership activities. Discussing each of these matters with partners ahead of time can help you avoid misunderstandings and strengthen your improvement effort.

Telling Partners about Your School's Needs and Constraints

Being clear with partners about the school's needs, expectations and constraints, and finding out about the partner's needs and expectations, will contribute significantly to the success of your partnership activity. The following are some categories of information you may want to discuss with partners about your school.

Resource constraints. Your school may not have equipment or supplies that your partner takes for granted. For example, museum staff from the New Mexico Rural Science Education Project were surprised to learn that few rural elementary classes have access to microscopes.

Timing constraints. Some partners may be unaccustomed to the rigidity of school schedules and the cost and logistical problems of arranging for substitutes, bus drivers, or extra adults to help with field trips. Partners need to know your scheduling constraints and know the consequences to you if they arrive late or cancel an activity at the last minute. Likewise, you will need to be sensitive to your partner's scheduling constraints.

Audience characteristics and needs. It is the school contact person's responsibility to inform the partner of audience characteristics such as the number and grade levels of students, numbers of teachers and/or parents, and how much exposure these audiences have had to the information that will be presented.

Performance expectations. The partner's training session, presentation, tour, or demonstration needs to be relevant and appropriate for its intended audience. Again, it is the school contact person's responsibility to explain the goals, structure, and appropriate instructional approach of an activity. The partner must be able to adapt to the audience's level so that attention is captured and the participants engage in learning. This applies to teachers and students alike, but is particularly apt for children. We suggest that you agree upon desired learning outcomes in advance and note any points to receive special emphasis or attention.

Addressing Liability and Safety Issues

Liability is a primary consideration in engaging in any type of school activity. It is the school district's responsibility to assure that students and teachers are taken care of in the best possible manner and are not exposed to any danger. There also may be a certain amount of liabil-

ity assumed by the school for partners who come to the school campus. Usually partners will be covered by their own insurance at the company or the agency where they work, but it is wise to obtain a liability release for the school's protection. We also suggest that the partner and school contact person discuss thoroughly, in advance, any possible health, safety, or property damage risks associated with a demonstration, presentation, or field trip.

It is also wise to ensure that there is adequate supervision for all students. If there are students with special needs, additional assistance may be required. A general rule of thumb is to have one supervisor (parent, administrator, teacher, etc.) for each five to seven students for a field trip and one supervisor for each ten students at a school demonstration. All members of the supervision team need to be oriented in advance to the planned activity.

Here are some additional safety tips that we suggest you provide to both teachers and partners:

- Be sure that a teacher (or some other legally responsible person) is present at all activities. In no case should a teacher "turn the class over" to a presenter or guide and leave the classroom or field trip site. Teachers' experience with students can often prevent otherwise dangerous situations before they arise. Also, if a mishap should occur it is best that a teacher be present to direct emergency measures.

- Investigate field trip sites in advance, and be alert as to potential hazards.

- Always have a first aid kit available on field trips or other outings; review your first aid skills on a regular basis.

- Make sure you have adults on any field trip or outing who are knowledgeable in first aid techniques and who know the directions to the nearest emergency health facilities.

- Avoid hazardous experiments, animals, insects, or locations.

Scientific Ethics

There are a variety of legal and ethical issues to be considered, and conveyed to students, when conducting science activities. Field trips to the natural environment need to be preceded by a careful investigation of possible legal restrictions to land access and the collection of any specimens. There are also ethical and environmental considerations, e.g., avoid ecologically sensitive areas; return rocks that are moved to their original location (they might be someone's roof); never take more than is needed; be aware that many insects, spiders, fish, lizards, etc. require special care in captivity if they are to be kept alive; and when something special is found, remember that someone else might think it is special also and would like to see it in its natural setting. Students can be taught to leave a natural setting with no evidence of their visit. (Some environmental organizations use the motto, "Take only pictures and leave only footprints.")

There are many situations in which specimen collecting may be acceptable. Some geological formations have seemingly limitless supplies of rock specimens, and collection by visitors is even encouraged. Some invertebrate fossils -- like brachiopods in New Mexico, for example -- are also abundant. Insect collecting is a common activity for children. Taking such collections back to the classroom can add to the overall climate of the room. However, five specimens of a particular mineral or plant are not needed; students can be encouraged to limit what they take.

Some items students may encounter on a field trip are definitely "off limits." Examples of these include eagle feathers, eggs, human artifacts, and rare and endangered species. If any of these are found, they should be left alone and the proper authorities should be notified. Accidental discoveries of significant natural history specimens have occurred over and over again. The discoveries of the mosasaur, seismosaurus, 280 million-year-old reptile footprints, and the jaw of a tyrannosaurus rex in New Mexico were all reported to the proper authorities. Subsequent investigation by qualified personnel has led to an increase in scientific knowledge and enjoyment for many.

The most important factor is for the teacher or organizer of the field trip to seek the appropriate agencies to obtain information on collection ethics and laws, and to then make the rules and their reasons an important issue with students. Partner agencies can help you learn about laws and ethical standards related to land access, collection, and conservation. Useful agencies to contact include science and natural history museums, U.S. Forest and Fish and Wildlife Services, state game and fish commissions, local tribal councils, Sierra Clubs, and naturalist societies. Sample guidelines distributed to teachers by the New Mexico Rural Science Education Project are presented on the following pages.

A final consideration in this category: Scientific knowledge has innumerable applications. Many of them, from the use of nuclear energy to the testing of cosmetic products to the dissection of frogs, are a source of ethical debate. It is not your job -- nor teachers' job, nor partners' job -- to impose your personal values or ethical beliefs on students. However, you can encourage both teachers and partners to recognize and respect the different perspectives that exist regarding a great range of scientific applications. You can emphasize the importance for students to learn as much concrete information as possible about a given issue or application, to weigh the evidence, and to draw their own conclusions about whether the benefits outweigh the costs. You can encourage teachers and partners to instill in their students the habit of open-minded inquiry and investigation.

Cultural Traditions and Norms

Respect for the cultural traditions and norms of all groups within the community is also an important consideration in teaching science. It is an easy thing to do some informal research to discover what ethnic or religious beliefs should be taken into consideration during the course of study. For example, among traditional Navajos bears are of special significance. To ask a Navajo child to pretend to be a bear or to examine a bear skull as part of a learning activity could violate that child's norms and beliefs.

New Mexico Rural Science Education Project
Suggested Collection Policy

1. Students will be taken to fossil collection sites and will be allowed to collect up to four fossils each. Crinoids, brachiopods, petrified wood, and bryozoans are all okay to collect.

2. Please collect only on the land designated for collection by the Museum. Remember that you are collecting under the Museum's supervision and permits. The Museum will be held accountable for improper or unethical collecting.

3. Stress the importance of not over-collecting a site.

4. Please take the time to look at *all* the fossil specimens collected. Even if the chances are very slim that anything of importance will be found, there is still that "chance in a million" that a student will find something valuable that should be brought to the attention of Museum staff. If such a fossil is found, please stress the possible importance of the fossils; explain that such a fossil can be more useful in a museum or university than in a private collection.

5. Any VERTEBRATE fossils are *not to be collected*, but should be reported to the Museum. There are laws protecting the collection of fossil vertebrates. Remember that the value of a fossil is drastically reduced when it is removed from its original location.

6. Please do not allow the students to collect any archaeological materials or artifacts. There are strong Federal laws prohibiting collection of archaeological remains by unauthorized persons.

7. If time permits, have the students do some recording of locality information. Have them locate the site on a map, describe the color of the rock, the type of matrix rock or dirt the fossil was found in (sandstone, shale, limestone), and any associated fossils.

8. Never forget that there may be a budding scientist in your group. Take time with the students and encourage questions. Don't be afraid to say, "I don't know" and look up the answer later for the student.

New Mexico Rural Science Education Project
Information about Land Ownership and Collecting Policies

Private Land. Collecting is at the discretion of the land owner. Land owners can claim all fossils collected on their property; therefore, permission must be obtained not only to collect but also to keep any fossils found.

Municipal Land. Land owned by municipalities should be treated the same as private land; city permission must be obtained to collect.

State Land. Permission should be obtained from the State Land Office. Some states, such as New Mexico, have no clearly stated procedure to obtain permits to collect. *This does not mean that a permit to collect is not needed.* State lands are generally closed to public access.

Indian Lands. As with private land, collecting is at the discretion of the tribe, Indian nation, or pueblo; permission must be obtained not only to collect, but also to keep the fossils found. Make it clear that fossils *and not archaeological materials* are to be collected. Initial contacts can be made through the Bureau of Indian Affairs or the Tribal Council.

Bureau of Land Management (BLM). A paleontological permit process exists for collecting vertebrate fossils from Federal lands administered by the BLM. Permits are granted to professional paleontologists or their designated agents affiliated with a museum or university. No permission is needed to collect fossil plants or invertebrates on BLM land. There is a limit on the amount of petrified wood an individual can collect: 250 pounds per year per person.

Other Federal Lands. Collecting in National Parks and Monuments is usually discouraged. Jurisdiction is customarily under the individual Park or Monument manager. To collect on Forest Service lands, contact the District Ranger.

Please remember the difference between a *paleontological* and an *archaeological* specimen. Archaeological specimens are any remains that indicate human activity: potsherds, arrow heads, etc. There are very potent federal and state laws preventing collection of such artifacts on *any* type of land. *Avoid collecting any archaeological artifacts!* Permits to collect fossils *do not cover* the collection of archaeological materials.

If you find something you cannot identify or which you think may be of importance, contact the Museum or a local university. If any doubt exists, leave it in place, exactly as you found it!

It is helpful for partners and teachers to know about such traditions, so they can avoid placing children in an awkward or uncomfortable position. If a student refuses to participate in an activity because of cultural traditions or religious beliefs, urge teachers to treat such responses seriously and with respect.

You can also encourage teachers and partners to highlight, in a positive way, the value to our country of having a mix of cultural traditions and perspectives. They can discuss with students approaches to scientific inquiry and the use of scientific knowledge among different cultures. Teachers can present learning activities that draw on cultural traditions; for example, a teacher from the Los Lunas, New Mexico, School District has developed an activity focused on the use of medicinal herbs in traditional Hispanic households.

Assuring Full Participation of Students with Disabilities

Students with disabilities -- whether physical mobility, hearing or visual impairment, or developmental delays -- should be able to participate fully in the kind of hands-on science program recommended here. In fact, our suggested focus on integrated, multisensory teaching techniques is a critical element in special education. You can offer suggestions and guidelines to both partners and teachers, reminding them that a little extra effort can result in access to the world of science for students with disabilities. Here are a few suggestions you can pass on:

- For students with mobility impairments, select field trip or field school sites that offer handicapped access. (Many National Forest lands and parks provide wheelchair access on designated trails.) Field trips need not always be away from the school; a playground surrounded with plants or bounded by a field, or a nearby pond with a level access path can provide hours of teaching time.

- For students with visual impairments, use activities involving auditory, tactile, and kinesthetic learning. Many activities can be easily adapted. You can also take advantage of the often enhanced hearing abilities of students with visual impairments by asking them to note what they hear on field trips or nature trails.

- For students with hearing impairments, use activities involving visual, tactile, and kinesthetic learning. Again, many activities need only slight adaptation to include all students.

- For students with developmental delays, emphasize concrete learning.

- If your school develops a nature trail, make sure it offers access to students with mobility impairments. Include braille notations on station signs; provide braille or audiotaped versions of trail guides.

It is helpful to inform partners in advance of the needs of all members of the student (or teacher) group, and to assist them in planning learning experiences in such a way as to provide a comfortable means of participation for individuals with special needs.

Taking Positive Steps to Overcome Stereotypes

Stereotypes can be conveyed in subtle as well as overt ways -- through the illustrations in textbooks, the number of times a teacher calls on a student or praises a student's answer, or the often unconscious assumptions many of us make about who will be afraid of handling a frog or reluctant to get their hands muddy. Positive steps to overcome stereotypes due to gender and ethnicity are needed throughout the educational program. However, science activities need particular attention, given the much lower participation rates in science courses and careers among women, Hispanics, African Americans, and Native Americans. All students can be encouraged to take an interest in science regardless of their gender or ethnic background.

You can offer teachers and partners models and guidelines to help them examine their own stereotyped beliefs and encourage all students (and teachers) to participate fully in science activities. Encourage them to provide information about scientists like George Washington Carver (agricultural scientist), Jose Delgado (a Yale researcher who studied the effects of electrical stimulation on the brain), and Marie Curie (the only person in history to win two Nobel prizes, for physics and chemistry). You can encourage teachers to invite women and minority speakers to their classrooms, and help them to identify such speakers. Encourage teachers and partners to assure an equal mix of children in small group or team activities, and to be equitable in selecting students for special duties and in calling on and praising students.

An excellent instructional strategy for reducing stereotypes, building students' self-esteem, and improving relationships among students of different racial, ethnic, or cultural backgrounds is *cooperative learning*. Cooperative learning is an instructional strategy in which small groups of students work together to meet common learning goals. Student groups are heterogeneous not only in terms of students' ethnicity or gender, but also in terms of students' performance levels. The learning task presented to the group requires the active participation and interaction of every student in the group; the task cannot be completed successfully if only one or a few students do the work of the entire group. Moreover, every member of the group has an equal opportunity to succeed at the task, whether they are high, average, or low achievers. Cooperative learning has resulted in higher achievement among students at all grade levels; it is particularly effective in strengthening students' thinking skills. The following sources offer helpful background information or learning activity ideas that can be adapted for science studies.

Circles of Learning: Cooperation in the Classroom (1986)
D.W. Johnson, R.T. Johnson, and E.J. Holubec
Interaction Book Company
7208 Cornelia Drive
Edina, MN 55435
(612) 831-9500

Cooperative Learning: Resources for Teachers
(Revised, 1987)
Stewart Kagan
Resources for Teachers
27134 Paseo Espada #202
San Juan Capistrano, CA 92675
(714) 248-7757

Team Up: Activities for Cooperative Learning, K-6 (1990)
National Education Service
1821 West Third Street, Suite 201
P.O. Box 8
Bloomington, IN 47402

6. WAYS TO INVOLVE PARENTS

Parents can be among your most valuable partnership resources. They can take on any of the roles we have described for partners; in addition, they can fill a variety of supporting roles. Perhaps most important, they can help to support and reinforce the instructional goals of your science improvement effort outside the school environment.

Roles for Parents

In most rural areas parents have always been actively involved in the education of their children, helping with homework, participating in field trips, serving on committees, or serving as a member of the school board. However, parents' roles can encompass much more, from classroom tutoring to helping design and construct playscapes for the school yard. Parents are also demanding more accountability of the school system and participating more actively in decisions that affect classroom instruction. It is possible to draw on this concern and interest as you implement science partnerships.

Parents can be involved in your effort in many different and important ways, including as:

- recruiters or "spotters" of partners and resources, or representatives from a partner agency, organization, or business,
- fundraisers,
- volunteer science teacher aides,
- tutors, in school or at home,
- science role models, in school or at home,
- classroom presenters, or
- assistants on field trips or in field schools or other outdoor classroom activities.

Rural parents who traditionally have supported their school and their community are likely to respond favorably to increased participation in the education of their children. The role of teaching and extending learning as a tutor, field school instructor, or classroom presenter may require some encouragement and support, however, as some parents may experience some apprehension about taking on an instructional role. They may need positive reinforcement to believe that they do indeed have important knowledge and experiences that will be valuable to the education of other children as well as to their own. Most parents, when aware of what children are learning, can reinforce those concepts and experiences at home. This is especially true in science. Many rural people use science processes daily. If they farm, ranch, run a small

business, manage a home, operate a drug store, or work as a nurse, for example, science is likely a part of their daily activity. Their knowledge and the application of that knowledge to their lives are valuable resources.

As you recruit parents, it is helpful to reinforce the idea that rural parents have special expertise and access to science resources. An example from the New Mexico Rural Science Education Project was a science field day on the Dulce Indian Reservation. The field day was planned for students and teachers, but many parents also attended. They participated with obvious enjoyment in the activities and worked with the children and teachers. Some parents knew a great deal about plants, the soil, insects, animals, and the terrain. Some, whose families had lived in the area for generations, were more knowledgeable than the guest "experts." Not only did they extend students' learning, they made the day much more interesting for everyone. For the children there was a great sense of pride that their parents had taken the time to participate, to learn, and especially to teach. The success of the field day with its strong parent involvement increased support for the project in the community.

Ways to Identify Parent Interest and Expertise

Surveying parents. A parent survey can be a useful way to identify interest and expertise. The survey can be brief and informal, to minimize both your effort and that of parents in completing it. If your community includes limited English-speaking populations, we strongly recommend that you provide questionnaires in the parents' home language as well as in English.

Before you send the survey home, it is helpful to let parents know it is coming. You can do so with a preliminary letter describing your science improvement effort and warning parents that the survey is coming, with a notice in the school newsletter, and/or with a reminder on the school billboard. (A sample letter to parents and interest survey form are included on the following pages.) After you have summarized the results of the parent survey, we suggest that you send the summary and a thank you letter to parents. The thank you letter allows the communication loop to be completed and helps assure parental support the next time cooperation is requested.

Other recruiting strategies. Even if you conduct a parent survey, we suggest that you use additional channels to inform and recruit parents. Some parents may be too busy, too preoccupied, or too intimidated to fill out survey forms; some may be unable to read. To reach all parents, use a variety of strategies, including presentations at parent-teacher association or other school meetings, special meetings held to publicize your effort, and individual parent contacts made by teachers, members of your Science Improvement Team, or other parents.

Orientation and training. For an intensive parent involvement effort, it is helpful to offer one or more orientation or training sessions. These sessions can be used to familiarize parents with the goals and focus of your science program, relevant instructional and classroom management techniques, school policies, and legal and ethical considerations. Partner agencies may be able to help you plan and conduct parent training sessions.

Sample Letter to Parents

Dear Parents,

The Del Norte Elementary School is implementing a "hands-on" science program. Its purpose is to increase students' interest in science by showing them how science relates to their own lives and community. The new program will focus on the natural resources right around us -- plants, wildlife, geology, weather. It will include demonstrations, field trips, and other special activities. Teachers will continue to use their science textbooks, but in the process of learning children will be exploring the local area and will be deeply involved in observing, listening, trying, and doing.

To help with this new program, we are looking for "partners." Partners may be parents, grandparents, or business or community people who are willing to devote their time, knowledge, and expertise to help children learn. Partners may sponsor an activity, help with field trips, present a science lesson or demonstration, serve as a classroom aide, or act as tutors. Partners may donate equipment, specimens of minerals or plants or the like, or other materials. Or they may help to raise funds or to identify other partners.

Partners are helpers, and parents have always been the school's most valuable partners. Next Monday your child will bring home a questionnaire asking about your interest and any special knowledge, materials, or ideas you may have that can help us. *Remember: You needn't be a scientist or an "expert" of any kind to be a valuable resource!* You may know a lot about the wildlife in this area; you may know the medicinal value of wild plants or herbs. You may use scientific processes as part of your job. Or you may just be a concerned parent, interested in helping strengthen your child's education.

We welcome your suggestions and hope you will participate with us in the development of this program. A member of the Science Improvement Team will contact you if you offer to help.

I appreciate your time and interest; only by working together can we can help all our children learn and succeed.

Sincerely,

Principal
Del Norte Elementary School

Sample Parent Interest Survey

Dear Parents,

The Del Norte Elementary School is looking for help -- from parents, community volunteers, and other agencies -- to improve our science program. As a parent, you can help in many ways. You can donate your time to help with field trips or outdoor science classes. You may know a lot about the plants or wildlife in this area, or about some other aspect of science. You may work somewhere that would make a great field trip site. You may have a rock or butterfly collection, or other materials you could present to classes. Or you may know other people or places that you can suggest to us. However you are able to participate, your time, interest, and help will be invaluable to our school.

To let us know about your interests, please complete the following questionnaire and return it to the office by Monday, October 10.

1. Would you be willing to serve as:

   _____ a volunteer science teacher aide?

   _____ an assistant on field trips or with outdoor classes?

   _____ a classroom presenter, demonstrating some aspect of science, conducting a science lesson, or showing the class a collection of specimens?

   _____ a classroom tutor?

   _____ a home helper?

   _____ a fundraiser?

   _____ other: _____?

2. Please check any specific areas in which you have a particular interest:

   _____ water _____ soil

   _____ electricity _____ climate

   _____ solar system _____ magnets

   _____ energy _____ plants

   _____ animals _____ rocks

_____ grasses _____ wind

_____ fossils _____ weight

_____ other: _____

3. Please describe any special interest, training, or education that would be useful in our science program:

4. Does your work or business involve science-related activities or processes that could be related to the classroom learning experience?

___ Yes ___ No ___ Need More Information

If your answer is "yes" or "need more information," please describe:

5. Would you be willing to help supervise students on field trips?

___ Yes ___ No ___ Need More Information

6. Please list any other individuals, businesses, or agencies that have an interest or involvement with science that you might help us contact:

7. If you have any questions, comments, or ideas about our science program plans, please let us know:

Thank you for your help.

7. ASSESSING RESULTS

On-going evaluations of your efforts are important for several reasons; the primary one is improvement. For individual activities (a workshop, a field school) as well as for general checks on progress (an initial profile of teachers, an end-of-year program review, a student assessment of growth in science skills), evaluative information about the program can help you adjust your approaches and improve your effectiveness. Such on-going evaluation can help you determine not only whether the school's objectives are being met, but also whether your partner's objectives are being met.

From this vantage, evaluation needs to be viewed in relation to both needs-sensing and planning. Needs-sensing provides the context for the work to be done; in this case, by giving information about the status of science teaching at your school (see Chapter 3). Planning, when it is informed by needs-sensing, leads to the development of a program that addresses identified needs within the constraints of both the school and your partners. Once the program is implemented, evaluation then provides information about its operation and effects, information that can be fed back into planning (along with additional needs-sensing) to make improvements as the program progresses.

As with other elements of your science improvement program, partners can help with evaluation. Partner agencies or individuals can help identify simple but effective evaluation methods, identify or develop evaluation instruments, and/or conduct evaluations of specific events or your program as a whole.

Needs-sensing and Planning

As mentioned earlier, a needs-sensing survey is helpful at the beginning of a project. First, it can help you gather information about the status of science instruction -- e.g., the attitudes teachers have about science teaching, the amount of time they spend teaching science, the resources they employ, and the obstacles they perceive. Second, discussing the results of your survey can help you build interest and ownership within the school. If teachers see you asking for information about their needs, see you openly discuss what was learned, and help you plan a program that addresses their identified needs, then the program you implement will have a greater legitimacy in their eyes. Teachers will have a much greater sense of ownership in the implemented program, and this will help its success.

Needs-sensing does not have to be a static activity, conducted once at the beginning of an effort and never more. Needs-sensing can be on-going, using both formal methods (e.g., survey instruments, focus groups) and informal methods (observation, discussion with individual participants). Indeed, needs-sensing is best used as an on-going activity, for once your program is implemented, you will likely encounter obstacles that could not be anticipated in

planning the program. A good needs-sensing effort will identify these difficulties, and the information gathered can be used in making program modifications.

Just as needs-sensing should be on-going, so should planning. You may find it helpful to bring participants together at key junctures in the program (e.g., end of a year's worth of activities, beginning of a new program year) to review what has gone right and what has gone wrong. If such information is freely shared in an atmosphere of collegiality, it can be used to collaboratively plan for program modifications. Again, the more collaboration involved in planning, the greater the likelihood of success in implementation.

Evaluation

There are a number of ways to look at evaluation of your science improvement efforts. For the purposes of this guidebook, we have identified the following three:

- event evaluations, which focus on isolated program components (such as training workshops, field schools, and summer training institutes) and their effects on participants,
- impact evaluations, which focus on outcomes for students who have been taught by teachers participating in the program (thus, an indirect effect of the program), and
- program evaluations, which look at the overall set of activities that comprise the program.

Event evaluations. We recommend that you plan and produce individual events with evaluation in mind. Share objectives and goals with teachers in advance of their participation. Whenever possible, contact a sample of participating teachers in advance, seeking information about the specific needs and objectives of those who will attend. You (and/or partners conducting the event) can use this information to shape presentations and activities, avoiding what is the downfall of many such activities -- irrelevance to the target audience. We also suggest that you give (or have partners give) post-event evaluation forms to all participants, asking about:

- how well the event addressed its stated objectives and the needs of participants,
- how useful the materials presented seemed to be,
- what changes in format, presentation style, or content would improve the event,
- what benefit the participants might have gotten from the event, and
- what follow-up would be useful to further strengthen their classroom work.

In some instances, you may want to design and administer pre- and post-tests focused on the content of the event. These can be useful in determining whether teachers have learned the specific information presented.

After the event is over, you may want to hold a debriefing session. Partner representatives, a few key participants, your school contact person, and any key administrators who have been involved in the program can discuss the event and note changes needed to improve future efforts or follow-ups that might strengthen the intended results. You may also want to contact a sample of participating teachers several weeks or months after the event to assess its long-term usefulness.

Impact evaluations. Most school boards and community or funding agency supporters will want to know whether or not the programs they support are having any influence on the children they are designed to serve. Generally they will want to know whether students' attitudes toward science and/or academic performance that reflects science skills are showing improvements. Associated with each of these are numerous indicators of attainment. For example, knowledge of science can be assessed through standardized test scores, school grades in science, quality of student science projects, and demonstration of science skills. Student attitudes toward science can be assessed through self-reports of attitudes, participation in science activities, and parental reports of student attitudes.

By convening a set of knowledgeable teachers, administrators, and partners, you can look at the options available to you and determine which of these indicators are both feasible and useful for the purposes of your program. For example, one strategy is to examine the standardized tests the district is using, identify items that reflect science knowledge (the test publisher should have such information available), and decide whether or not the content of your program addresses those test items. If it does, you can track student performance over time on the selected items as one indicator of student impact. If not, then other ways of assessing student science skills (e.g., through a customized instrument or through systematic observation) will need to be discussed. These types of assessment can become very technical, however, and you might seek consultation from a district evaluation expert or from area university personnel.

Program evaluations. In program evaluation, you seek information about the effectiveness of the overall program as perceived by its various "stakeholders" -- those who have an interest in how the program is working (e.g., partner representatives, school administrators and board members, teachers, students, and parents). To accomplish this task, you will first need to generate a fairly complete description of the program: what activities have been provided, over what period of time, to what participants, and with what apparent success or lack of it. With such a description, you can generate questions about the key components of the program and seek information about how those components have been perceived by the various stakeholders (either through printed surveys, individual interviews, or focus group discussions).

Next, you can summarize the views of the various stakeholders and make recommendations for program improvements based on those summaries. Finally, you can share this information with stakeholders and feed it into your planning process for subsequent work.

Instrumentation

In carrying out these evaluations, do not be afraid to construct your own instruments. Keep in mind the focus of your evaluation effort (i.e., the specific program elements of interest) and draft questions that unambiguously seek information relevant to that focus. Of course, it is a good idea to let someone else (a colleague, a participating teacher, a partner) review your draft instrument to see if their perceptions of its clarity match yours!

In designing instruments you will be forced to consider whether to obtain quantitative and/or qualitative data. The advantages of quantitative data are that they can be easily summarized. For example, using a five-point scale, you can ask participants to rate how useful a certain activity was, and then compute an average rating to summarize the set of responses. Alternatively, you can ask an open-ended question (e.g., describe the most useful aspect of the activity) and then summarize the responses you receive with respect to a classification scheme that you have developed. In the latter case, the data will be much richer, but summarizing them will be more difficult.

To take a second example, you might ask participants how they generally present a given topic (qualitative data); alternatively, you can provide a list of the possible ways to present the topic (ways that interest you and your work with the program) and ask participants to indicate which ones they use (quantitative data). As a rule of thumb, quantitative approaches can be employed when you know in advance what response categories are appropriate; when you do not know these categories in advance, a qualitative approach will probably be more productive.

In closing, the most important thing to remember about evaluation is that it serves program improvement -- if you carry out evaluation simply to please a funding source, then it is not likely that the results of the evaluation will have any positive influence on the program. Indeed, such evaluation efforts can negatively influence the program if relevant information is collected and then ignored.

8. FUNDING YOUR PROGRAM

The partnership activities we have described in this guidebook are designed to be free or extremely low in cost to the school district. In some cases, however, you may need funds to support certain activities -- staff development, for example, or the purchase of equipment or materials. Or you may want to seek funding for your improvement effort as a comprehensive program package, preparing plans and budgets as you would for any other externally funded project.

Whatever the level of your fundraising needs, partner agencies and individuals can be of tremendous help. If they have resources to expend, they can serve as a direct funding source. Or they can assist in other ways, including:

- planning, sponsoring, and conducting fundraising drives or events,
- researching and identifying other potential funding sources,
- "opening doors" by introducing you to potential funders with whom they have established relationships, or by writing letters of support,
- advising or helping you to prepare funding plans, budgets, and applications,
- offering access to funding sources to which you would otherwise be ineligible to apply. As a school, for example, you may not be eligible for government or foundation funds that are earmarked for museums. However, by establishing a partnership program with an area museum, you may be able to apply for a portion of such funds as a co-sponsor or subcontractor. *The reverse is also true:* You can help partner agencies to qualify for certain grant programs by pursuing joint ventures. This is often an incentive to potential partners for working with schools.
- making contributions that can strengthen your applications to other potential funders. For example, your ability to demonstrate partners' "in-kind" contributions of time, materials, or equipment can add to the appeal of grant applications to government agencies or foundations. Or a local partner with modest resources, such as the Lions Club, may contribute start-up funds to help demonstrate the viability of your program and the community's support for your effort. Most funders, from businesses to foundations, are more likely to contribute to a program that can demonstrate a broad base of financial support.

Defining Your Funding Needs

The first step to take before initiating any fundraising efforts is to make a thorough list of your funding needs, and then to prioritize those needs. Such planning will help you avoid a common fundraising mistake -- identifying a single funding need, securing a source for the funds, and then discovering *other* (usually larger) funding needs that could have been covered by the same source, if only you had known to ask.

Your Science Improvement Team, or whoever has been planning your science partnership program, is a logical choice to develop a prioritized "wish list." The Team may need some assistance, from an experienced partner or from your school's budget expert, in thinking through all the possible cost categories and attaching dollar estimates to materials or activities.

Developing Funding Strategies

The next step is to match your list of funding needs to a set of funding strategies and potential funding sources. These may range from asking the local Rotary Club to buy compasses for all third-grade students, to holding bake sales so that a class can travel to a science exhibit, to applying for a grant supporting a summer science camp. Again, partners, members of the Science Improvement Team, and/or other school volunteers are likely candidates for completing the planning and research involved in this task.

Identifying potential funding sources. You may already have spotted some potential funders in your search for partners (see Chapter 4). In addition, you may want to research the possibilities for government, foundation, and corporate grants. A number of national and state directories and periodicals list grant possibilities; most city and university libraries include these publications in their collections. (Check with the reference librarian for assistance.)

In addition, the Foundation Center, an agency whose function is to provide information about foundation grants, has established one or more Foundation Center libraries in every state. These libraries include extensive information about national, state, and local foundations and the kinds of grant programs they fund; they keep on file copies of many foundations' annual reports, which usually list the programs and institutions the foundation has funded in recent years. Foundation Center libraries also maintain information about government and corporate funding. The librarians are knowledgeable and eager to help. *For the location of the Foundation Center Library nearest you, call 1-800-424-9836. Or write the Foundation Center, 79 Fifth Avenue, New York, NY 10003.* Other sources to contact for possible funding leads include your local Chamber of Commerce, the state department of education, any agencies or consultants with which you have a cooperative relationship, and your area's regional educational laboratory.

Here is a list of some potential funding sources:

- **Local businesses** can make modest contributions that can be used as start-up funds; to purchase consultant services, materials, or equipment; or to underwrite field trips or field schools. They also can contribute merchandise your program can use or raffle off.

- **Local organizations**, including parent-teacher, community, and civic groups, often raise funds to contribute to worthy causes.

- **Corporations** may establish their own foundations or other mechanisms for contributions, which are usually made within specified geographic areas. Local corporate offices may have discretionary funds for making relatively modest contributions (usually less than $5,000); often only an informal request is sufficient for such a contribution. (Local offices also may donate equipment or materials.) Larger grants may be available through the corporate foundation; the application process is generally similar to that for foundation or government grants. Having the support of a representative from the local corporate office will greatly strengthen your application.

- **Area, state, and regional foundations** usually are established for specific philanthropic purposes; education is one of the most heavily funded categories (though substantial amounts are earmarked for higher education). Your best funding opportunities are with local or area foundations; state and national foundations generally look for projects that will have a statewide or national impact.

- **State agencies** sometimes have discretionary funds, often channeled from the federal government, for pilot or short-term programs. Often the availability of these funds is not well publicized; it helps to establish and maintain communications channels with the state department of education and other agencies as well.

- **Federal agencies** sponsor a broad range of grant programs designed to improve educational services; most of these are within the U.S. Department of Education, but there are other sponsoring agencies as well, from the National Science Foundation to the National Endowment for the Humanities. Again, many federal discretionary programs are not well publicized among rural, small schools, so it is wise to cultivate contacts with partners who can serve as watchdogs on your behalf. Regional education service centers, colleges and universities, and state education agencies usually subscribe to the *Federal Register*, which makes grant announcements; to *Commerce Business Daily*, which posts notices of potential contract awards; or to newsletters (such as *Federal Grants and Contracts Weekly* or the *Chronicle of Philanthropy*) that list upcoming grant and contract opportunities. You may be able to identify a contact person at one of those institutions who will look for opportunities in your specific area of interest.

As an alternative or in addition to tapping the above-listed funding sources, you may want to consider sponsoring -- or finding partners to sponsor -- fundraising events. Raffles, bake sales,

car washes, golf tournaments, community suppers: these familiar methods for raising funds can be effective and can help generate community enthusiasm for your efforts. The ideal situation is to find a partner organization that will take on the entire responsibility of planning, organizing, and conducting such events, freeing you and your staff for other work.

Another funding strategy is to link up with other school districts, to strengthen the appeal of your program and broaden your eligibility for grant funds. A consortium approach can increase your prospects among foundations, corporate funders, and government grant programs.

Targeting your efforts. Once you have identified and researched a range of potential funding sources and strategies, you can begin to assess the match between your needs and those prospects. Here are several important questions to consider in matching funding needs with funding strategies:

- **Does your need address the funding source's purposes and resources?** You need to know a lot about potential funders before deciding to approach them -- what major areas they fund (e.g., health, education, the arts), what their priorities are within those general categories (e.g., higher education, educational research, curriculum development), what geographic or other restrictions they maintain, and the size of grant or contribution they are likely to make. Look for the best possible match in every area -- program purpose, amount of funding, and geographic service area.

- **Do you appear to have a good chance of success?** As you probably know, fundraising is an increasingly competitive activity, and your staff's energies are already stretched thin. Concentrate your fundraising energies, then, on the activities that seem to have the greatest likelihood of success. Some possible indicators are: a close match between your needs and the funder's priorities (see above); a need or program idea that relates to an area of intense local concern or that has recently received strong public attention; a personal connection, such as a school board member who works for an area corporation, or a state department of education staffer who is willing to express strong support; and a close match between your fundraising resources (a good grantwriter, a group of parents willing to work long and hard) and the fundraising task at hand.

- **Will the return be worth the effort?** Sometimes even a fundraising activity with a strong potential for success is not worth the effort. There are two dimensions to this question. First, some fundraising activities may require a high output of time and/or money for a relatively small return. If that return is all you need, fine; if not, consider whether you could invest the same energy and resources in another activity to produce a higher yield.

  The second dimension of this question relates mostly to grant programs, which sometimes can be quite prescriptive in their program requirements. You may learn about a "pot of money," available through a foundation or a federal or state government agency, that is set aside to fund a specific kind of science education program. Before applying for such funds, we urge you to consider thoroughly the match between your local program needs and the

grant's program requirements. Often it is tempting for a school to modify its existing plans in order to assure eligibility for a grant program. Such modifications may not be a problem, and may even strengthen your program. *In some cases*, however, the modifications may cost you more than the grant program is worth -- not necessarily in terms of money, but in terms of local effectiveness and support. The danger is that the required modifications may be so extensive that your original goals and purposes are lost. You and your Science Improvement Team or other planning assistants need to determine, as clearly as possible, whether the grant program truly meets your local needs, whether your school is prepared to implement the program according to the timetable required, and whether you can sustain the program once grant funds expire.

Contacting Funding Sources

Your approach to contacting potential funders, of course, will depend on the funder and your relationship to them. There are, however, several guidelines that should be useful in any circumstances:

- As much as possible, familiarize yourself with the funder's purposes, guidelines, and requirements *before* you submit a letter of inquiry or make other personal contact. Most foundations issue annual reports and/or guidelines that describe their operations and expectations; most government programs also issue guidelines. Call or write for such information and review it thoroughly before making any appeal.

- Know what you plan to do with the funds before you ask for them; be prepared to discuss your plans in specific terms.

- Go through channels; follow any instructions or restrictions issued by the funding source. (If a grant program's guidelines say no telephone inquiries, for example, don't call.)

- Line up your sources of support before contacting the funder. If you have a personal contact who can put in a good word for you, be sure to brief that person beforehand and obtain permission to "drop" her or his name. If you are counting on support from another agency or organization to lend credibility or substance to your application, be sure to touch base with them before claiming such backing; obtain an official letter of support whenever possible.

Letters of inquiry. For most business, organization, and foundation funders, your initial -- and sometimes only -- contact likely will be a letter of inquiry. This letter, which may vary from one to four pages depending on the scope of your effort, serves essentially as a "mini-proposal"; it should describe your purposes, proposed activities, potential impact, and other sources of support in addition to making a specific funding request.

You can include attachments, such as a proposed budget and any program flyers, newspaper write-ups, and the like; however, be conservative and avoid overwhelming the funder with material. Remember: The letter of inquiry is as important as a full-blown grant proposal and warrants as much care and attention in its preparation.

Unless the funder prohibits it, you can follow up with a telephone call ten days to two weeks after sending the letter of inquiry. Use the call to make sure the letter has reached its destination, to see whether additional information is needed, and to ask whether a person-to-person conference would be appropriate.

It is usually most effective to have a highly placed authority -- the superintendent, principal, or school board president -- issue the letter of inquiry and make any follow-up contacts. Such a strategy sends a clear message to the funding source: This project is important to us. If you are able to arrange for a personal conference with the funder, it is appropriate to have a member of your planning team, an active parent, or another partner representative accompany the senior school representative. However, both people need to be able to discuss the proposed project knowledgeably and answer any questions the funder may have.

Grant proposals. For many foundation and most government programs, you will need to submit a grant proposal. The potential funder probably will specify guidelines for the proposal's content and organization; many government programs even specify the sequence and section titles for the proposal narrative. As you develop your proposal, *always follow such guidelines to the letter*, even if they do not make logical sense to you or offer the best format for presenting your particular program ideas.

In the absence of specific guidelines for proposal content, we suggest that you include the following information:

- the local needs that the project will address, i.e., a rationale for its usefulness and significance,
- the long-term goals and short-term, concrete objectives to be accomplished (you can draw on the goals developed by your Science Improvement Team -- see Chapter 4),
- an implementation plan describing major activities and how they will be carried out,
- a timeline for completion of major activities,
- a description of staff responsibilities and qualifications,
- an evaluation plan indicating how you will determine the extent to which project goals and objectives have been met, and

- a budget listing project costs, the school's financial and/or in-kind contributions, and any funding or in-kind support from other partners.

As with the letter of inquiry, you also may want to attach copies of letters of support and any materials that demonstrate the program's substance and community support.

Getting Help to Implement Fundraising Plans

Identifying potential funding sources, cultivating contacts, preparing applications, and sponsoring activities can be incredibly time consuming. Fortunately, partners can help in many ways, including researching funding sources, investigating the cost of equipment or materials, drafting program descriptions or grant applications, preparing publicity materials, or conducting fundraising events. You may find local people with expertise in grantwriting or program development. University colleges of education, regional educational laboratories, regional service centers, and other agencies can provide technical assistance in developing proposals, as can individual consultants. There are also a number of publications that can help guide your fundraising efforts. One particularly good fundraising guide is *Securing Your Organization's Future: A Complete Guide to Fundraising Strategies* (1987), by Michael Seltzer, published by and available from the Foundation Center, 79 Fifth Avenue, New York, NY 10003. This book and others should be found in many libraries, including the Foundation Center libraries discussed earlier in this chapter.

9. YOU CAN MAKE A DIFFERENCE

As you reflect on the potential use of collaborative arrangements for your particular school or district, you might consider three important contributions partnerships can offer your educational program. First, partnerships produce short and long term advantages for students. There is the immediate enrichment of science instruction that makes science more meaningful and interesting to students. This can translate over time to better achievement in science and to a wider range of higher education and career choices.

Second, there are short and long term benefits for teachers. Their repertoire of teaching skills and knowledge can increase and diversify; as they meet a new challenge, gain enthusiasm for teaching science, and see that enthusiasm spread among their students, teachers can find renewed interest and rewards in the teaching profession. Finally, there are long term benefits to be gained in school-community relationships. A successful school-community collaboration in science can lead to collaboration in other subject areas as well. As the community understands the school's needs, and becomes a partner in meeting those needs, overall support can strengthen the school district's entire educational program.

If you decide to embark on a partnership effort, here are some general suggestions to consider:

- Keep in mind the administrative structure of your district. Touch base with everyone you should in order to facilitate support for the new program.
- Involve your teachers immediately in considering and planning for partnerships.
- Communicate the goals of partnerships to parents and other patrons as early as possible.
- Cast your net for partners widely. Do not be discouraged if your local community proves unpromising -- look further afield.
- Explore collaborative arrangements with those public agencies whose mission includes a general educational mandate or a specific requirement to work with schools.
- Select partners whose skills, roles, and missions are relevant to established curricular goals and are appropriate for the ages and developmental levels of your students.
- Be realistic. Partnerships have to be nurtured, and time is already at a premium for you and your teachers.
- Give special support and encouragement to your teachers during the early implementation phase. They will be breaking new ground and may fear failure.
- Facilitate teacher inservice partnership opportunities whenever and wherever possible.
- Evaluate carefully and as fully as time and staff allow.

- Modify or change as dictated by evaluation results.

- Communicate, communicate, communicate -- to your staff, to students, to the community, to your partners.

What you want -- and what we want -- is for your students to have the best possible opportunity to learn scientific principles for application to their lives and to their future studies and/or careers. If the entire community is engaged in the pursuit of that goal, the likelihood is strong that it will be reached.

You are the instructional leader who can provide the impetus for pursuing that goal. Rural teachers are not the only people who often feel isolated and unsure; rural administrators also feel they are alone and overwhelmed as they pursue goals and look for solutions, resources, and alternatives. Just think: Those science partners can be your partners, too, and help you feel a little less isolated and alone. As the partnership program thrives and enriches your school's science education program, you can know that your leadership has made a difference in opportunities for your teachers, your students, and your community.

APPENDIX A
A HISTORY AND DESCRIPTION OF THE NEW MEXICO RURAL SCIENCE EDUCATION PROJECT

The New Mexico Rural Science Education Project (NMRSEP) began in 1986 as a cooperative outreach program initiated by the New Mexico Museum of Natural History in Albuquerque, and the New Mexico Center for Rural Education at New Mexico State University in Las Cruces. The original project was funded by the National Science Foundation (grant number MDR 8550535) as a research and development program to identify effective approaches for working with rural elementary teachers; the project's principal investigators were Jeffry Gottfried from the Museum of Natural History and Don B. Croft from the Center for Rural Education.

Year One, 1986 -1987. NMRSEP's first year involved five pilot school sites in rural New Mexico. Project activities focused on training and assisting teachers in the development of hands-on natural science kits. Kits were to include locally available natural history specimens, background material, and activities, all focused on teaching science concepts. Teachers were provided with information and field trips focused on local natural history, training in principles of science instruction and curriculum development, and strategies for building kits. NMRSEP staff also developed sample kits to be used as models by teachers.

The intent of the first-year effort was for teachers to develop kits that could be used by other teachers as well as themselves. Although many developed kits that they used productively in their own classrooms, few materials were polished enough for distribution throughout the district. Teachers found the information provided through the project's training activities and the task of developing the kits to be useful; however, they objected to the time, effort, and skills required to develop science activities in a polished form that others would read and use.

Year Two, 1987 - 1988. Based on the outcomes for Year One, NMRSEP staff shifted their focus during the project's second year in an effort to address teachers' preferences and constraints. Year two of the project, then, primarily involved three activities: sponsorship of natural history field schools, provision of individual support services to teachers, and the conduct of a five-day, intensive Summer Elementary Science Teachers' Institute (SESTI).

At the field schools, NMRSEP staff demonstrated hands-on activities with students, allowing teachers to observe interactive teaching methods that drew on local natural resources. Field schools were generally held at a site near the school, typically a national forest or tribal campground; most lasted two days, with younger elementary students participating one day and older students the next. After the field schools were over, NMRSEP staff prepared packets of information and suggested follow-up activities for teachers to use in the classroom. Staff also conducted follow-up meetings with teachers, working with them to integrate learning activities with the school's established science curriculum. Field schools were successful at generating student interest in science studies, teaching science concepts, and modeling hands-on teaching strategies. However, they were very labor-intensive for museum staff and did not prove to be a practical method of providing instructional support for teachers.

The summer institute was held in June, 1988, for two teachers from each of 10 rural school districts. NMRSEP staff and six volunteer specialists acted as instructors. Teachers and staff participated in a wide variety of science activities and explored the natural resources of the Circle A Ranch in the Nacimiento Mountains just east of Cuba, New Mexico, and other nearby areas. Through these activities, teachers gained extensive hands-on experience in natural science field studies. Teachers from each district met periodically during the week in order to adapt activities and approaches to their home environments and resources.

Year Three, 1988 - 1989. NMRSEP's third year marked the end of National Science Foundation funding and the beginning of a one-year effort funded by the New Mexico Commission on Higher Education. This grant was provided to the New Mexico Center for Rural Education, with Center director Everett Edington as project director. Staff from the Museum of Natural History were responsible (via a subcontract arrangement) for carrying out the project's instructional and support activities, with Center staff responsible for evaluating project efforts.

NMRSEP's Year Three activities were a culmination of what had been learned during the first two years of development. During Year Three, NMRSEP worked with 10 rural school districts, each of which paid a fee to obtain project services. Each district sent two teachers to the summer institute. In addition, NMRSEP staff conducted a field survey to identify local natural science resources and developed a customized resource manual for each area. Each district was provided with two full-day inservice workshops for up to 30 elementary school teachers. Inservice sessions consisted of field trips, presentations on local natural history, and hands-on activities modeled for teachers by NMRSEP staff. Project staff also mailed follow-up materials to each participant and encouraged teachers to contact them for ongoing assistance and resource materials.

Year Four, 1989 - 1990. In 1989, the Southwest Educational Development Laboratory (SEDL), which had identified NMRSEP as a "promising practice" for improving science instruction in rural schools, received a contract from the Office of Educational Research and Improvement, U.S. Department of Education to conduct the "Strengthening Science in Rural, Small Schools" project. This project, a cooperative venture involving SEDL (Wesley A. Hoover, Project Director), the Museum of Natural History (Michael Judd, Project Director), and the Center for Rural Education (Nora Hutto and O.D. Hadfield, Project Directors), was designed to refine and "package" NMRSEP's approach to rural science outreach and to make it available nationally to museum and rural educators. Through this project, the Museum of Natural History and SEDL have worked jointly to produce an implementation manual for museum educators, and to conduct a series of three demonstration workshops for museum educators. SEDL and the Center for Rural Education have produced this guidebook for rural school administrators. Finally, all three agencies have jointly sponsored and conducted a national dissemination conference for both museum and rural school staffs.

During this year, staff from the Museum of Natural History have continued to provide NMRSEP services to rural school districts on a fee-for services basis. Staff are developing plans to expand NMRSEP activities for the 1990-91 school year.

APPENDIX B
SOURCES OF FURTHER INFORMATION

Note: This listing is divided into three categories: books and other publications addressing aspects of science education; publications about educational partnerships; and agencies or organizations that can provide information or other resources.

Publications Related to Science Education

50 Simple Things You Can Do to Save the Earth and *50 Simple Things Kids Can Do to Save the Earth.* (1989). Earthworks Press, Berkeley, CA.

Althouse, R. (1988). *Investigating Science with Young Children.* Available from Teachers College Press, 1234 Amsterdam Ave., New York, NY 10027.

Audubon Adventures, a bi-monthly, illustrated elementary school level newsletter; available from the National Audubon Society, 613 Riversville Road, Greenwich, CT, 06831.

Butzow, C.M., & Butzow, J.W. *Science Through Children's Literature: An Integrated Approach.* Available through Teacher Ideas Press, Libraries Unlimited, Inc., P.O. Box 3988, Englewood, CO 80155-3988.

Cassens, J.R. (Ed.). (1988). *Nature's Classroom: A Program Guide for Camps and Schools.* (ED 303 309). Also available from American Camping Association, Bradford Woods, 5000 State Road 67 North, Martinsville, IN 46151-7902.

Chavarria, L.S. (1980). *Outdoor Education Nature Centers.* ERIC Mini-Review. Available from ERIC/CRESS (ED 191 639).

Druger, M. (Ed.). (1988). *Science for the Fun of It: A Guide to Informal Science Education.* (ED 303 318). Also available from National Science Teachers Association, 1742 Connecticut Ave., NW, Washington, DC 20009.

Horn, P.J. (1986). *Are You Game? Science Games in the Classroom.* (ED 309 923). Also available from Grand Canyon University, Campus Bookstore, 3300 W. Camelback Rd., Phoenix, AZ 85017-1097.

Lee, C.L. (1984). *Outdoor Education Activities for Elementary School Students.* ERIC Digest. Available from ERIC/CRESS (ED 260 873).

McCormick, A.J. *Outdoor Areas as Learning Laboratories: CESI Sourcebook.* A collection of information and activities on natural science subjects, available from the ERIC Clearinghouse for

Science, Mathematics, and Environmental Education, Ohio State University, College of Education, 1200 Chambers Road, Third Floor, Columbus, OH 43212.

Mitchell, Andrew. (1982). *The Young Naturalist.* An illustrated introduction to nature studies, available from EDC Publishing, 8141 East 44th Street, Tulsa, OK 74145.

Murphy, M. P. (Ed.). (1984). *Bubbles: Films, Foams, & Fizz. Ideas in Science.* Notes for Teachers. Washington, DC: American Association for the Advancement of Science. (ED 249 050).

National Science Resources Center. (1988). *Science for Children. Resources for Teachers.* (ED 303 320). Also available from National Academy Press, 2101 Constitution Ave., NW, Washington, DC 20418.

Outdoor Biology Instructional Strategies (OBIS). (1980). Modules including 97 activities for 10-15-year-olds, available from Delta Education, Inc., Box M, Nashua, NH 03061-6012, (606) 889-8899.

Perdue, P.K. (1989). *Small Wonders. Hands-On Science Activities for Young Children.* (ED 309 961). Also available from Good Year Books, Department GYB, 1900 E. Lake Ave., Glenview, IL 60025.

Project Wild Elementary Activity Guide (1983). Available from Project Wild, Salina Star Route, Boulder, CO, 80302.

Ranger Rick's Naturescope, a periodical available from the National Wildlife Federation, 1400 Sixteenth Street, N.W., Washington, D.C. 20036-2266.

Science and Children, a magazine for elementary school teachers, available from the National Science Teachers Association, 1742 Connecticut Ave., NW, Washington, DC 20009.

Tracks, an elementary school level newsletter, winner of the 1984 National Wildlife Federation Special Achievement Award. Available by subscription for individuals or entire classes, from Michigan United Conservation Clubs, P.O. Box 30235, Lansing, MI 48909.

Votaw, T.A. (1986). *Teaching K-6 Science in Small Schools on a Financial Shoestring.* ERIC Digest. Available from ERIC/CRESS. (ED 287 641).

Zielinski, E.J. (1987). *So You Want to Take a Field Trip.* (ED 299 079).

Publications Related to Partnerships

Atkin, J. M., & Atkin, A. (1989). *Improving Science Education Through Local Alliances: A Report to the Carnegie Corporation of New York.* Santa Cruz, CA: Network Publications.

Barrington, G. V., and Others. (1987). *Partnership Program Evaluation Study*, Calgary Board of Education. Edmonton, AB: Alberta Department of Education. (ED 297 141).

Bull, K. S. (1988). "Developing Community Resources to Support Rural Gifted Programs." In *Alternative Futures for Rural Special Education*, American Council on Rural Special Education, Western Washington University, Bellingham, WA 98225. (ED 299 738).

Business Roundtable. (1989). *Business Means Business about Education*. A Synopsis of The Business Round Table Companies' Education Partnerships. (ED 310 180). Also available from The Business Roundtable, 200 Park Ave., Suite 2222, New York, NY 10166.

Decker, L. E., and Decker, V. A. (1988). *Home/School/Community Involvement*. Arlington, VA: American Association of School Administrators. (ED 298 610). Also available from Publication Sales, American Association of School Administrators, Dept. 802, 1801 Moore Street, Arlington, VA 22209-9988 (Stock No. 021-00214).

Dransutavicius, F. (Ed.). (1988). *Partnerships in Education Resource Manual*. Hamilton, ON: Industry Education Council. (ED 298 343).

Freedman, S., & Aschheim, B. (1984). *Business and Education: Partners for Excellence*. The Proceedings of Five Regional Conferences. (ED 309 300).

Freedman, S., & Aschheim, B. (1985). *Industry-Education Partnership Guidelines*. Quincy, MA: Massachusetts State Department of Education. (ED 309 283).

Freedman, S., & Aschheim, B. (1988). *Innovation with Impact: Industry-Education Partnerships in Massachusetts*. Quincy, MA: Massachusetts State Department of Education. (ED 309 299).

Freedman, S., & Keenan, R. (1987). *Schools and Communities Working Together to Enrich K-12 Education, #II*. Promising Practices in Community Education. Quincy, MA: Massachusetts State Department of Education. (ED 309 286).

Hart, T. E. (1988). *Building Coalitions for Support of Education*. Eugene, OR: Oregon School Study Council. (ED 297 482). Also available from Publication Sales, OSSC, University of Oregon, 1787 Agate Street, Eugene, OR 97403.

Howley, C. B. (1988). *Economic Support for Education in Rural School Districts*. ERIC Digest. Available from ERIC/CRESS. (ED 308 059).

Industry Education Council. (1988). *Industry-Education Partnership Councils*. A Comprehensive Handbook for Local Action to Improve Industry-Education Cooperation. Hamilton, ON: Industry Education Council. (ED 298 344).

Killian, J. E., & Byrd, D. M. (1988, April). *Teachers' Perspectives on What Promotes Instructional Improvement in Rural Schools.* Paper presented at the annual meeting of the American Educational Research Association, New Orleans, LA (ED 301 402).

Kindred, L., Bagin, D., & Gallagher, D. (1990). *The School and Community Relations.* Englewood Cliffs, NJ: Prentice Hall.

Livermore, A. H., and Others. (1986). *How to Form and Operate a Local Alliance: A Handbook for Local Action to Improve Science and Technology Education.* Washington, DC: National Science Teachers Association (ED 307 169). Also available from Triangle Coalition for Science and Technology Education, National Science Teachers Association, 1742 Connecticut Ave., NW, Washington, DC 20009.

Moorefield, S. (1988). *The Burgeoning Adopt-a-School Movement.* Alexandria, VA: National Association of Elementary School Principals. (ED 300 921). Also available from Publication Sales, National Association of Elementary School Principals, 1615 Duke St., Alexandria, VA 22314.

Thomas, J., and Others. (1989). *Building Coalitions.* Eugene, OR: ERIC Clearinghouse on Educational Management. (ED 309 516).

Warden, J. E. (1986). *Establishing Partnerships between the Business Community and Rural Schools.* Available from ERIC/CRESS. (ED 287 650).

Agencies and Organizations to Contact

ERIC Clearinghouse for Science, Mathematics, and Environmental Education, Ohio State University, College of Education, 1200 Chambers Road, Third Floor, Columbus, OH 43212.

ERIC Clearinghouse for Rural Education and Small Schools (ERIC CRESS), Appalachia Educational Laboratory, P.O. Box 1348, Charleston, WV, 25323, (304) 347-0400. ERIC CRESS reproduces a variety of materials focused on small, rural schools.

National Alliance of Business, 1015 15th Street, N.W., Washington, D.C. 20005, (202) 457-0040.

National Association for Industry-Education Cooperation, 235 Hendricks Blvd., Buffalo, NY 14226, (716) 833-6346 or 846-4191.

National Audubon Society, 613 Riversville Road, Greenwich, CT 06831.

National Rural Development Institute, Western Washington University, Bellingham, WA, 98225; this umbrella agency includes several rural education coalitions (including the American Council on Rural Special Education) and publishes *The Journal of Rural and Small Schools.*

National Rural Education Association, 230 Education, Colorado State University, Fort Collins, CO 80523, (303) 491-7022. This association publishes *The Rural Educator* and*Country Teacher*.

National Science Teachers Association, 1742 Connecticut Ave., NW, Washington, DC 20009.

Private Sector Initiatives, Partnerships in Education, The White House, Room 134, Washington, D.C., 20500, (202) 456-6676.

Project Learning Tree (PLT), American Forest Council, 1250 Connecticut Ave., NW, Suite 320, Washington, DC 20036. Contact: Cathy McGlauflin, Director (202) 463-2455. An environmental education program for teachers of elementary and secondary students, Project Learning Tree is an excellent source of interdisciplinary learning activities. The program also provides workshops and inservice programs for teachers.

USDA-Extension Service (4-H), 3860 South Agriculture Building, Independence and 14th SW, Washington, DC 20250. Contact: Allan T. Smith, National 4-H Program Leader (202) 447-5332 or 447-5516.

USDA-Soil Conservation Service (SCS), P.O. Box 2890, Washington, DC 20013. Contact: Tom Leverman, Head, Educational Relations (202) 447-6475.

Woodsy Owl Program, USDA-Forest Service, P.O. Box 96090, Washington, DC 20090-6090. Contact: Janet Sledge, Manager of Cooperative Outdoor Environmental Program (202) 475-3785 or 447-5060.

NOTES

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Appendix 16

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